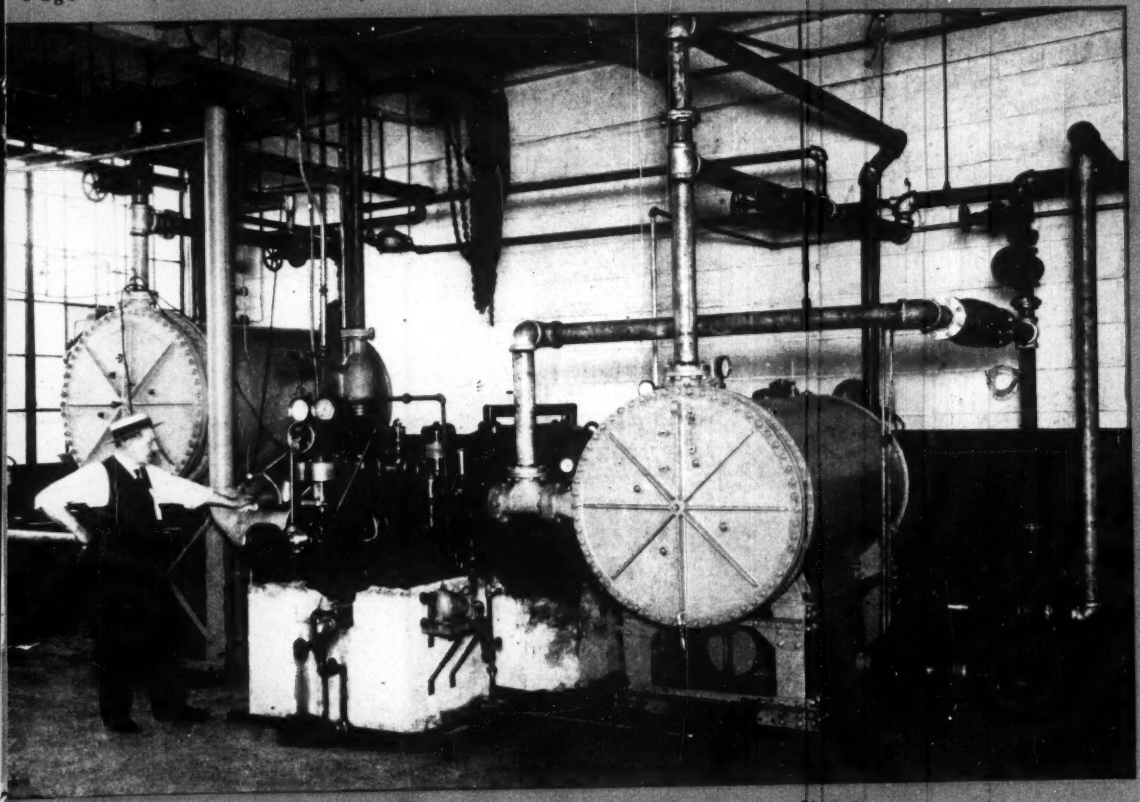
# Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

FEBRUARY ★ 1952

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

*Page 107—Journal Section of The American Society of Heating and Ventilating Engineers*



*Air conditioning's 50th birthday marked this year ..... page 84*

Power Plant Piping . . 88

Reflective Radiant Conditioning . . 75

Grandstand Heating . 82

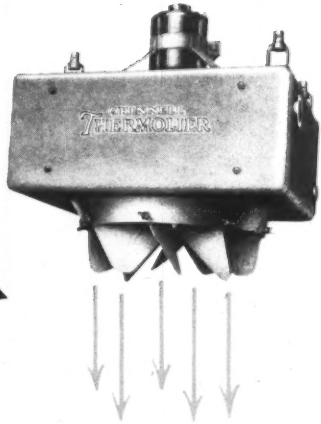
Complete Contents of This Issue . . . . 5

HOW TO JUSTIFY AN AIR CONDITIONING INVESTMENT . . . . . 71

# DOWNRIGHT

## better performance

Vertical Delivery
**THERMOLIER**
Unit Heaters . . .




# RIGHT DOWN

## where maximum heat is desired...

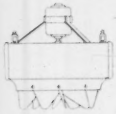
### in warehouses, plants and other hard-to-heat buildings

**HEATING COMFORT AND ECONOMY.** Heat is forced down to the working level . . . not banked uselessly at the ceiling level. Thermoliers provide quick heating from a cold start. Desired room temperatures are easily maintained within a close range.

**ADAPTABILITY TO EQUIPMENT AND FLOOR LAYOUT.** The units and the simple piping are overhead where they do not interfere with arrangement of operating machinery or equipment and do not take up valuable floor or wall space. Units are easily relocated at any time to meet changes in plant layout or heating requirements.

**LOW FIRST COST.** Thermoliers are so efficient and so compact that their heating capacity is often equivalent to the capacity of cast iron radiation or pipe coils of twice the cost.

4 MODELS . . . . . 18 SIZES


Vertical Delivery

Horizontal Delivery

Textile Model

Velocity Nozzle

A thermostatic trap, the simplest and least expensive of all traps, is practical because of Thermolier's exclusive cooling leg.

Maximum capacity assured, annoying destructive water hammer eliminated — by built-in pitch of tubes and internal cooling leg which assure continuous drainage of condensate.

Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

Safety and durability assured with leak-proof tube-to-header construction.

Five other important construction features. Write for Thermolier Catalog.

# GRINNELL

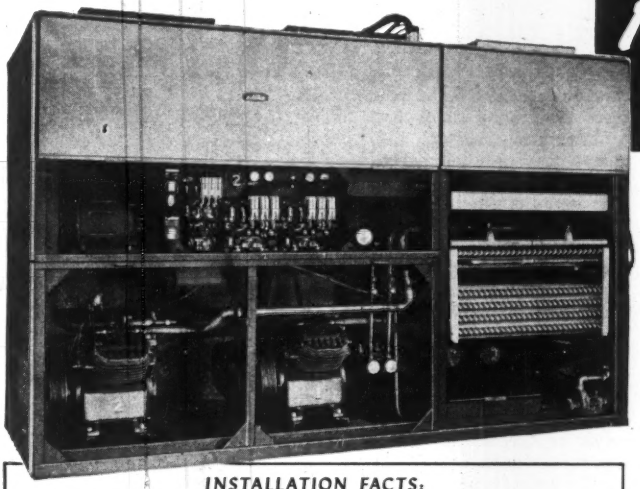
**WHENEVER PIPING IS INVOLVED**

Grinnell Company Inc., Providence 1, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems

# *Double* ECONOMY
# *Double* VALUE!

## *with a dual-circuit refrigerated Kooler-aire**



### INSTALLATION FACTS:

| UNIT | Nom. Cooling Capacity Tons | Length | Height | Depth | Compressor No. | Motor H.P. | Conditioner | | Condenser | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Blower C.F.M. | Motor H.P | Blower C.F.M. | Motor H.P. |
| DRK 10 | 10 | 95¾ | 61⅝ | 37¾ | 2 | 5 | 4000 | 1½ | 3700 | 1½ |
| DRK 15 | 15 | 114½ | 73⅝ | 41¾ | 2 | 7½ | 6000 | 2 | 4400 | 1½ |
| DRK 20 | 20 | 114½ | 73⅝ | 41¾ | 2 | 10 | 8000 | 3 | 5000 | 2 |
| DRK 25 | 25 | 125½ | 77⅛ | 48¼ | 1<br>1 | 10<br>15 | 10000 | 5 | 6250 | 3 |
| DRK 30 | 30 | 137½ | 84⅛ | 53¼ | 2 | 15 | 12000 | 5 | 7500 | 3 |
| DRK 40 | 40 | 146½ | 93⅛ | 60¼ | 2 | 20 | 16000 | 7½ | 10000 | 5 |
| DRK 50 | 50 | 187¾ | 105⅛ | 60¼ | 2 | 25 | 20000 | 10 | 12500 | 7½ |

## *COMPLETE CENTRAL STATION TYPE AIR CONDITIONER

Where varying load requirements must be met with exact capacity control the Dual Circuit Refrigerated Kooler-aire offers many unique advantages.

It has all the outstanding features of the regular R-K—a complete packaged air-conditioning plant including conditioner, compressor and evaporative condenser sections—*plus* two complete refrigeration circuits. Each unit consists of two compressors, two compressor motors and starters, dual circuit evaporator coil with two expansion valves, dual circuit condenser coil with two receivers and complete dual piping.

Units have unique internal wiring which provides for alternating lead compressor to insure even wear. Internal wiring is provided for use with a remote two-stage thermostat and time-delay relay.

The Dual Circuit Refrigerated Kooler-aire combines features of great flexibility. It is designed to provide—*double economy! double value!* by the exclusive usAIRco features that reduce maintenance, reduce operation costs and add to dependable long life!

**usAIRco**
*Everything In Air Conditioning*

**UNITED STATES AIR CONDITIONING CORPORATION**
**3300 Como Ave. S.E., Minneapolis 14, Minn.**

Please send me supplemental bulletin-94.

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

**PACIFIC TELEPHONE AND TELEGRAPH BUILDING—(1925)** Hot and cold water supply, vacuum and fire lines, drainage, drinking water and pump lines.

**PACIFIC GAS AND ELECTRIC BUILDING—(1925)** Cold water supply and fire lines.

**STANDARD OIL BUILDING—(1923)** Steam, return and water piping; roof leader lines, soil and waste lines 2" and larger; vent lines 4" and larger, 3½" and smaller; vacuum lines; gas piping; hot and cold water lines.

## In these San Francisco skyline structures

### maintenance is kept "down to earth" with

# Byers Wrought Iron Pipe

Although the designers of these eye-appealing San Francisco skyline buildings had different ideas on architectural treatment, they followed the same proven practice in safeguarding against premature failure and excessive maintenance by specifying genuine wrought iron for corrosive services. The photograph captions tell the story of the selective use of this time-tested material, and the wide variety of services it protects. Proof of the wisdom and soundness of these specifications is evidenced by the outstanding durability records established by the material since installation.

The reason for the unusual durability of genuine wrought iron comes from its unique composition. Tiny threads of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse attack, and so discourage local pitting. The fibers also anchor the initial protective scale, which shields the underlying metal.

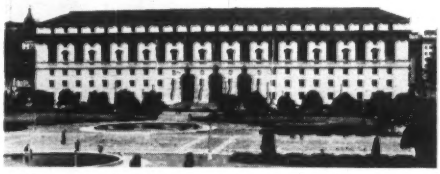
You'll find some helpful information in our bulletin, WROUGHT IRON FOR PIPING SYSTEMS. Write for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

**BALFOUR (GUTHRIE) BUILDING—(1920)** Plumbing and heating.

**ROYAL INSURANCE BUILDING—(1909)** Hot and cold water lines.

**STATE BUILDING—(1923)** Heating, cold and hot water supply, vacuum and fire lines, drainage and vents.



# BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

**WROUGHT IRON**

**TUBULAR AND HOT ROLLED PRODUCTS**

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

# Heating Piping & Air Conditioning

Vol. 24, No. 2

(with which is merged the Aerologist)

DESIGN, INSTALLATION, OPERATION AND MAINTENANCE IN INDUSTRIAL, COMMERCIAL, INSTITUTIONAL AND PUBLIC BUILDINGS



BOARD OF CONSULTING AND CONTRIBUTING EDITORS . . . .

N. R. Bernz, Leo F. Collins, Sabin Crocker, R. C. Doremus, Philip Drinker, M. K. Fahnestock, Walter L. Fleisher, F. E. Giesecke, William Goodman, William A. Hanley, J. J. Harman, G. W. Hauck, R. S. Hawley, E. P. Heckel, R. E. Hieronymus, J. C. Hornung, Lee P. Hynes, C. W. Kimball, Dwight D. Kimball, A. C. Kirkwood, Charles S. Leopold, Samuel R. Lewis, H. C. Murphy, Alfred J. Offner, F. B. Rowley, Robert P. Schoenijahn, Kalman Steiner, T. S. Tenney, Rush D. Touton, Eph. A. Tyler, W. H. Wilson

EDITOR . . . . C. M. BURNAM, JR.

ASSOCIATE EDITOR . . . . THOMAS V. JOHNSON

ASSISTANT EDITOR . . . . AILEEN H. BURNS

ADVERTISING STAFF . . . .

Wallace J. Osborn and Robert J. Osborn, New York—Murray Hill 9-8293 . . . . Robert A. Jack, Cleveland—Yellowstone 2-1540 (after Feb. 25, Evergreen 2-1540) . . . . James D. Thomas and George C. Cutler, Chicago—State 2-6916 . . . . R. P. Wettstein, Los Angeles—Dunkirk 8-2286, Portland—Atwater 4107, San Francisco—Yukon 6-2522

PUBLISHER . . . . FRANK P. KEENEY

MANAGER . . . . CHARLES E. PRICE

CIRCULATION DIRECTOR . . . . FRANK S. EASTER

PRODUCTION MANAGER . . LAWRENCE A. DOYLE



Published monthly by the Keeney Publishing Co., 6 N. Michigan Ave., Chicago 2, Ill. Telephone: STate 2-6916. Subscriptions: U.S. and possessions, $3.00 per year; Canada, Cuba, Mexico, Central America, South America, $4.00 per year; other, $6.00. Current copies, U.S. and possessions, 35c each; back copies, 60c each. January 1952 issue, $1.50 per copy. For change of address, notify publisher and your local postoffice of both old and new addresses by the 15th of the preceding month. Member Audit Bureau of Circulations and Associated Business Publications, Inc. Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc.


Copyright 1952 by the Keeney Publishing Co.


Entered as Second Class Matter May 18, 1929, at the Post Office at Chicago, Ill., U.S.A., under the Act of March 3, 1879. Additional entry at Mendota, Ill.




## Features


How To Justify an Air Conditioning Investment ..... 71

Fuel Conservation According to Season ..... 74

Operating Results With Reflective Conditioning ..... 75

Taps Power from the Sun ..... 81

How To Heat a Grandstand ..... 82

Air Conditioning's 50th Birthday ..... 84

Power Plant Piping ..... 88

How To Check Insulation for Efficiency ..... 95

Cathodic Protection of Underground Piping ..... 96

Simplifying Choice of Air Conditioning Equipment ..... 98


## Departments


The Editor's Pages (news and notes) ..... 63

"Open for Discussion" ..... 67

The Law and Your Profits (warranty of installation) ..... 101

Question of the Month (trap discharge; diesel shop exhaust) ..... 102

Sam Lewis' Page (practical comment) ..... 105

Data Sheet (new artificial respiration method) ..... 106

Equipment Developments ..... 179

Who's What ..... 194

New Books and Reports ..... 204

Meetings and Conventions ..... 208

Recent Trade Literature ..... 212

Index to Advertisers ..... 222


## ASHVE Journal Section


Physiological Adjustments To Sudden Environment Changes ..... 107

Cooling Water System for Engineering Development Center ..... 111

Honored by Life Membership ..... 118

Warm Air Perimeter Heating: Temperature Drop in Ducts ..... 119

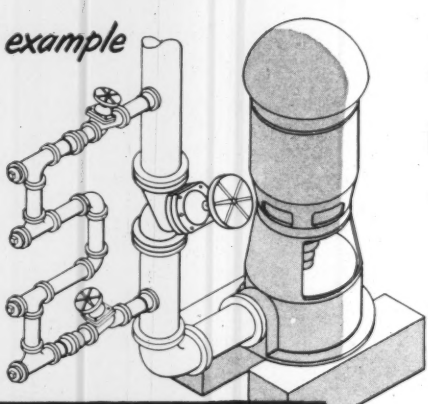
Warm Air Perimeter Heating: Heat Loss from Floor Slabs ..... 128

Summary of Chapter Meetings ..... 136

Candidates for Membership ..... 142

Officers, Council and Committees ..... 147

# How's This For Solving a Valve Problem ...on Corrosive Well Water, for example



## THE INSTALLATION

On outlet of well water pump supplying plant of Barr Rubber Products Co., Sandusky, Ohio. Sulphur content of water extremely high.

## THE HISTORY

Valves formerly used here lasted no more than 6 months. Under constant exposure to severe erosive and corrosive effects, they failed to provide the easy operation and positive seating needed in this service. They required excessively frequent re-packing and seating maintenance.

Problem solved by replacing with Crane Packless Iron Body Diaphragm valves in main line and by-pass. Installed more than a year, they show no corrosion, no effects of service. Operate smoothly, seat tightly, with no maintenance needed to date.

## VALVE SERVICE RATINGS

| | |
|---|---|
| **SUITABILITY:** | Just what was needed |
| **MAINTENANCE COST:** | None to date |
| **CORROSION-RESISTANCE:** | No evidence of corrosion |
| **SERVICE LIFE:** | Outlasted any 2 other valves so far |
| **OPERATING RESULTS:** | Pump shutdowns for valve repairs stopped |
| **PRICE:** | Much less than alloy valves |
| **AVAILABILITY:** | Stock item in Crane line |

## THE VALVE

Crane No. 1611 Iron Body Packless Diaphragm Valves featuring separate disc and diaphragm. No packing to maintain; no stem leaks. Neoprene diaphragm used to seal bonnet only. Independent disc with neoprene insert insures positive seating even should diaphragm fail. Also fully neoprene lined valves. Many common and corrosive services. See your Crane Catalog or Crane Representative.

*The Complete Crane Line Meets All Valve Needs. That's Why,*

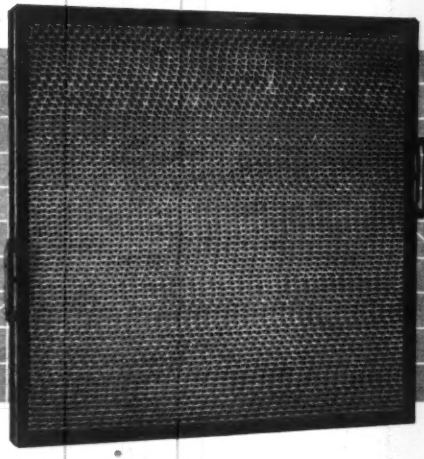
**More Crane Valves Are Used Than Any Other Make!**

# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
*Branches and Wholesalers Serving All Industrial Areas*

***VALVES • FITTINGS • PIPE • PLUMBING • HEATING***

# Now you can have



*Performance Rated*

**air filters**

## FAR-AIR* originates greatly improved testing methods that take the guesswork out of air filtration!

All architects, engineers and reputable filter manufacturers know this important fact about air filters: *no filter–regardless of its design–operates at equal efficiency under all dust conditions.* For example, a filter may stop "gravel" with 100% efficiency, but may have 1% efficiency when exposed to dust particles of 0 to 5 micron size. (1 micron–1/25,000 inch.) The new FAR-AIR testing methods accurately rate filter efficiencies under *all* dust conditions – not just one set of laboratory conditions using a "standard" test dust, as in the past.

THIS IS IMPORTANT TO YOU because, for the first time, you can buy air filters whose performance rating under *your* operating conditions is accurately determined in advance. No more guesswork when you buy FAR-AIR filters! You may also save needless expense by installing the type filters that are no more efficient than necessary to meet the requirements of the job.

This tremendous advancement in the science of air filtration is ready to serve you now. Your nearby Farr Field Engineer can be of valuable assistance in solving your air filtration problems. Why not call him today?

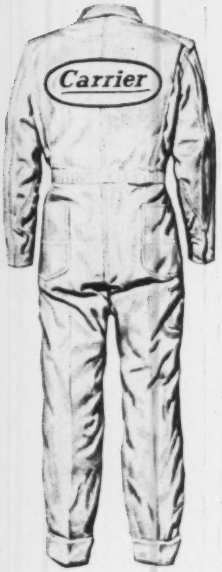
Write today for your copy of the free booklet on the new Farr testing procedures, which gives full technical information on the equipment used in these tests and the results obtained. Address: Farr Company, P.O. Box 10187, Airport Station, Los Angeles 45, California.

*Trade Mark Reg.

**FARR COMPANY** *Manufacturing Engineers*

Los Angeles • Chicago • New York

Mf'd under license by Control Equipment Co., Ltd., Montreal, Canada




# Want a look at the overalls picture?

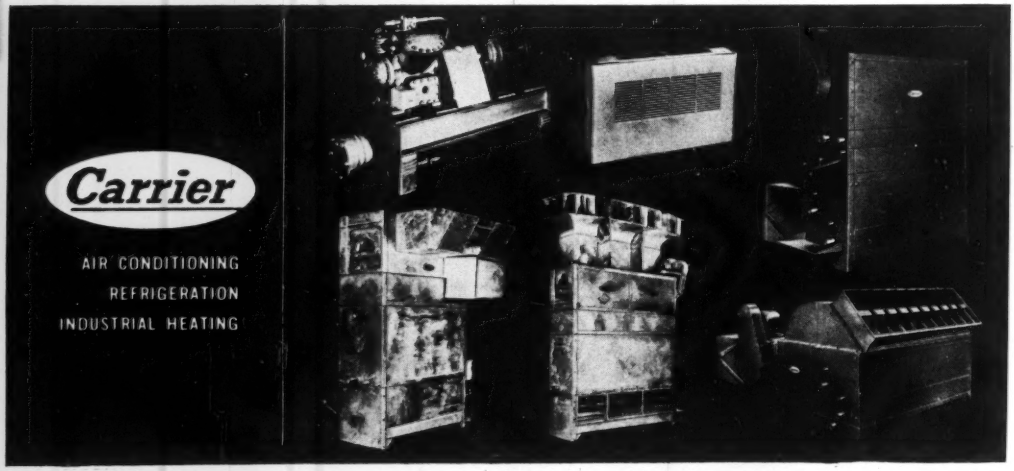
When we build the equipment you sell, we figure the Overalls Factor to be mighty important.

That's why there are always overalls in the Carrier picture. In all departments from drafting room to production line, there are men who have that certain "know-how" they got by working with equipment in a variety of applications.

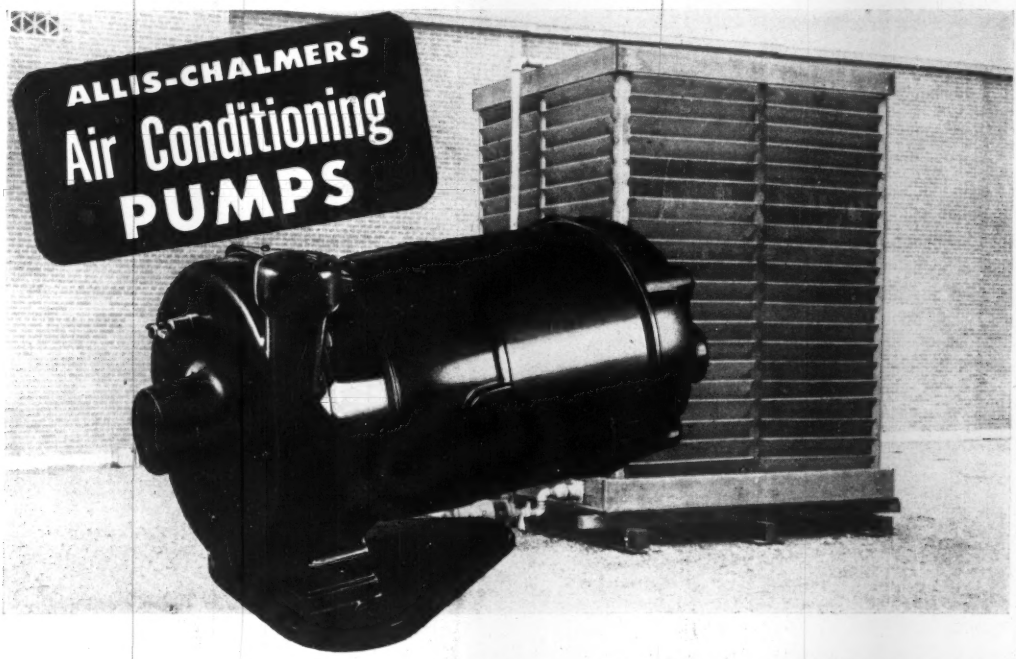
It's only with their experience behind us that we can design and manufacture equipment that's going to do the job for your customers . . . that can be easily installed and serviced by you.

That's what makes the Carrier line so exceptional. It's a family of products built with you in mind . . . a family of products matched in size, performance and quality to put the most flexible air conditioning tools in your hands.

For instance . . . for small or medium size buildings there's a choice of systems to meet your needs. There's the Carrier low-pressure Weathermaster duct system with its volume control for individual rooms. And, for air conditioning the larger open spaces of multi-room buildings, such as meeting and assembly rooms, stores, restaurants and the like, there's the Carrier System and Zoning Weathermakers — each sectionalized to be fitted into your requirements for both comfort and industrial air conditioning. Carrier Corporation, Syracuse 1, New York.




REFRIGERATING COMPRESSORS DUCT WEATHERMASTER SYSTEM WEATHERMAKERS
EVAPORATIVE CONDENSERS COLD DIFFUSERS ZONING WEATHERMAKERS




# We Help You SOLVE Your PUMP PROBLEMS

ONE OF THE BIG PROBLEMS in air conditioning work is engineering the circulating system. Even though you may know how to do it, it's a place where Allis-Chalmers engineers can save you time and effort.

They will help you work out problems like these:

- **How big a pipe will I need?**
- **How big a pump will I need?**
- **Where's the best place for the pump?**

All in all, you are assured of a perfectly engineered job! As for the installation itself, that is the simplest part of an air conditioning job when Allis-Chalmers circulating pumps are used. All it takes is three mounting bolts, a few pipe fittings, two wires and the silent, smooth-running pump is installed. No maintenance problems either!

Try Allis-Chalmers on your next job. You'll find the pumps can't be beat; prices are in line; and service is fast and good. Call your nearby Allis-Chalmers district office, or write, Allis-Chalmers, Milwaukee 1, Wisconsin.

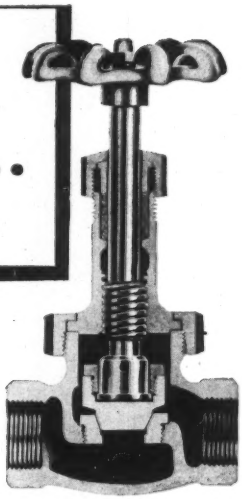
A-3572

## 5 FEATURES of Allis-Chalmers Package Pumps

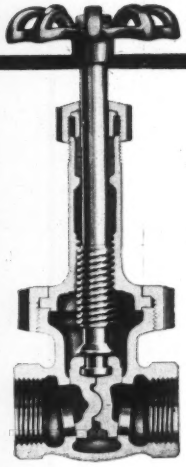
1. Standard Motor — These fractional horsepower pumps are built with NEMA standard motors of a well-known brand. Built-in thermal protection provided.
2. Mechanical Seal is used rather than the usual packing gland. Mechanical seal doesn't leak and requires no regular maintenance.
3. Closed Impeller is accurately die cast of special bronze. Impeller has smooth surface and high hydraulic efficiency. It is carefully machined and balanced for quiet operation. Impeller can easily be removed with screwdriver and Allen-type wrench.
4. Rotatable Casing — Discharge may be placed in any of four directions.
5. Easy Installation — Motor and pump are a single complete unit which is simply bolted in place. No extra parts to buy.

**ALLIS-CHALMERS**

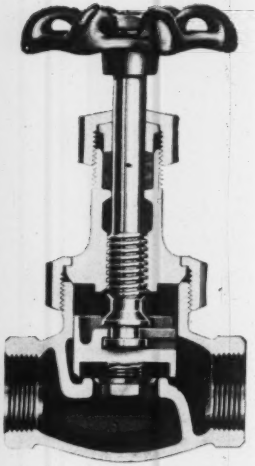
# Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



Walworth No. 95 Globe Valve
Re-New-Disc

## built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:

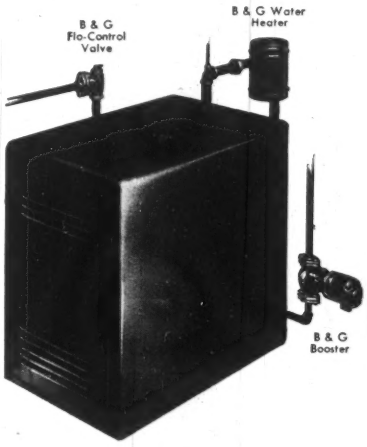
**WALWORTH**
**valves and fittings**

60 EAST 42nd STREET NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

# Hydro-Flo* Heating, of course

***with modern baseboard heating panels***




***B & G Hydro-Flo Heating equipment can be installed on any hot water heating boiler, new or old***

For comfort, the areas around large, low windows must be adequately heated . . . and a B & G *Hydro-Flo* Forced Hot Water System with baseboard heating panels is an ideal way to do the job. Baseboard panels fit neatly under low windows . . . raise a blanket of warmth against incoming cold . . . keep room temperature virtually uniform from floor to ceiling.

Heated water circulated through the baseboards by a B & G Booster is automatically controlled so that the heat supply is always *matched to the weather!* No wasteful overheating—even in spring and fall, when only a little heat is needed.

Plenty of hot water, too, for automatic washers, baths and showers. The Water Heater of a B & G *Hydro-Flo* System furnishes an ample volume, winter and summer. Send for catalog of B & G *Hydro-Flo* Heating Products.

*Warm draftless floors*

*Inconspicuous heating units*

*All year 'round hot water*

**BELL & GOSSETT**
**COMPANY**

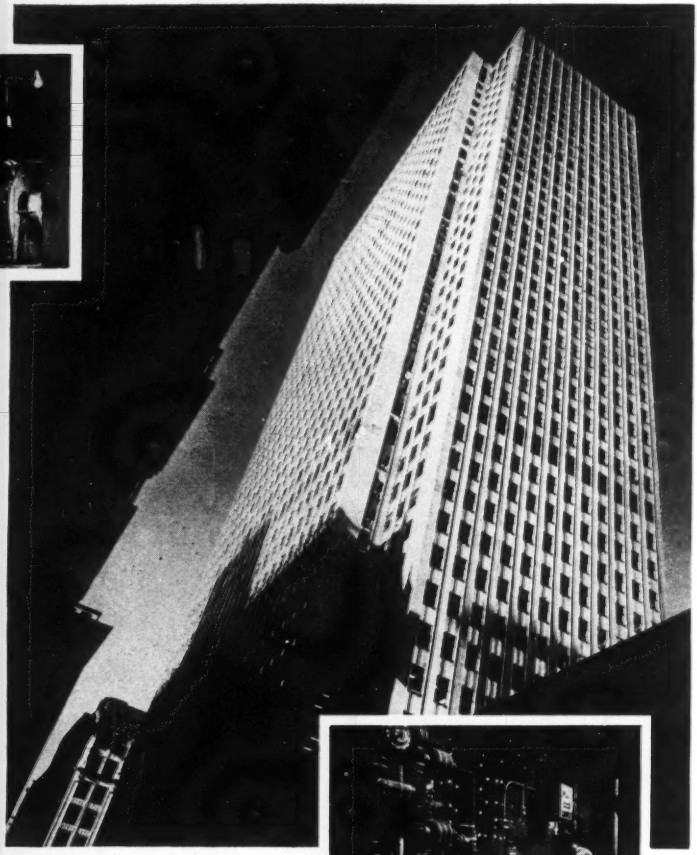
**Dept. CJ-5, Morton Grove, Illinois**

*Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto, Canada*

*Reg. U. S. Pat. Off.

Architects: Harrison & Abramovitz, N. Y.; Consulting Engineers: Meyer, Strong & Jones, N. Y.

Seventy-nine Sturtevant fans circulate half a million cubic feet of air a minute the year 'round, quietly, smoothly.

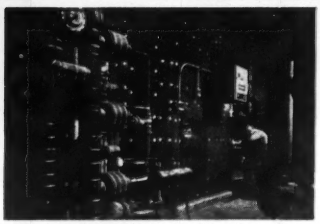


# FRESH CLEAN AIR FOR A SKYSCRAPER

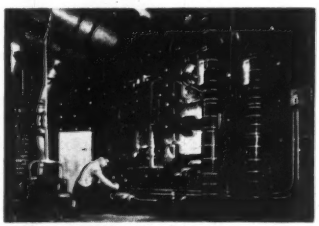
It takes plenty of air to make an ultra-modern skyscraper the efficient workplace it was designed to be. For example, look at Pittsburgh's new 525 William Penn Place Corporation Building which houses the U. S. Steel Corporation and the Mellon National Bank & Trust Co. Air is the medium which keeps this building warm in winter, cool in summer—comfortable and healthy all the year 'round.

Dependable Sturtevant fans and dehumidifiers were specified for use with the heating, ventilating and air conditioning system of this massive structure. In a portion of the building, electronic air cleaning by the Westinghouse PRECIPITRON® removes dirt, soot, pollen—even smoke—from the air, will pay for itself many times over in reduced cleaning costs.

The complete line of Westinghouse equipment helps you *put air to work* . . . with air conditioning, air moving or air cleaning. Contact your local Sturtevant office, or write to Westinghouse Electric Corp., Sturtevant Division, Hyde Park, Boston 36, Mass.



Air isn't just cleaned, it's electronically-purified. 8 Westinghouse PRECIPITRON units slash cleaning costs.



19 Sturtevant Dehumidifiers wring 660 gallons of water per hour from the air on muggy days, humidify on dry days.

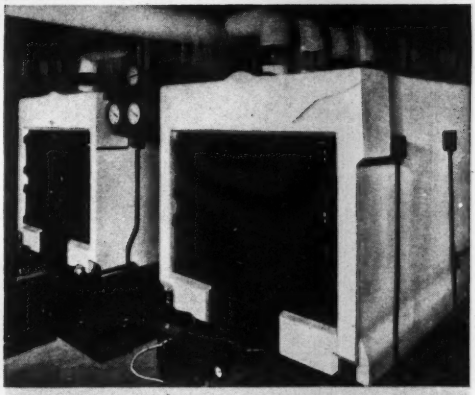
**YOU CAN BE SURE... IF IT'S Westinghouse**

J-80245

# AMERICAN-Standard

**First in heating...first in plumbing**

Sixth and Denny Branch of Seattle-First National Bank. Architect: John W. Maloney, A.I.A.; Mechanical Engineer: DeWitt C. Griffin & Associates; Mechanical Contractor: Routman Plumbing & Heating Co.; General Contractor: General Construction Co. All are Seattle firms.



A battery of two or more Redflash Boilers provides a heating plant of extreme flexibility. In cold weather the entire battery will team up to take care of the load. On mild days the fluctuating demand for heat can be efficiently handled by one of the boilers, thus effecting desirable economies in fuel.

## *Seattle's Most Modern Bank installs Redflash Boilers*

**Newest branch is fifth in large state-wide system to be heated by AMERICAN-Standard equipment**

● One of the nation's fastest growing banks is the Seattle-First National. And it is one of the most progressive. Operating a state-wide system of branch offices, this great institution now ranks 24th in deposits among all banks of the country.

The attractive building shown above is the fiftieth and newest branch to be opened. Known as the Sixth and Denny Branch and located in the heart of Seattle's northern downtown business district, this modern banking building incorporates many unique banking facilities, including drive-in banking and a large parking area.

Another feature which reflects this important bank's sincere interest in the health and comfort of its customers . . . and its own personnel, is the installation of two American-Standard Redflash Boilers to insure dependable and efficient heat and operating economy. Redflash Boilers have also been installed in four other recently opened branches.

### Redflash boilers provide economical heating for your commercial jobs!

Expertly engineered and sturdily constructed, the Redflash Boiler can be installed singly or in battery to provide an abundance of heat for large residences or commercial buildings of practically any size. Its scientifically proportioned combustion chamber, direct heating surface, and long flue travel for hot gases assure highest heat output with the least fuel. The Redflash Boiler and other large size oil fired heating units in the American-Standard line are sold through selected wholesale distributors to heating and plumbing contractors.

### *Easy to Install...*

**Redflash Boilers are shipped in sections, so that even the largest size is easily moved through a door or elevator hatch. Can be assembled quickly without tearing down walls or shifting heavy equipment.**

**American Radiator & Standard Sanitary Corporation, P. O. Box 1226, Pittsburgh 30, Pa.**

*Serving home and industry*

AMERICAN STANDARD · AMERICAN BLOWER · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

# Famous Labels suggest the choice



Many of the big textile mills . . . names your wife will recognize . . . "air-control" many of their manufacturing operations with Worthington air conditioning and refrigeration.

And many of the famous shops where the mills' products are sold . . . Saks Fifth Avenue, The Higbee Company, J. L. Brandeis, Lane Bryant, many Sears Roebuck Stores . . . are air-conditioned by Worthington.

No other manufacturer makes so complete a line. A Worthington system is all Worthington-*made*—not just Worthington-assembled—assuring you of perfectly balanced operation and unit responsibility.

Worthington Pump and Machinery Corporation, Air Conditioning and Refrigeration Division, Harrison, New Jersey.

America's Leaders... in Many Businesses... Select

## WORTHINGTON

A-2.9

AIR CONDITIONING AND REFRIGERATION

**The Most Complete Line... Always the Correct Recommendation**

# GET DOUBLE PROTECTION!

## ONLY STAYNEW

### AUTOMATIC AIR FILTERS HAVE THIS DRY CURTAIN.....

Staynew Model A-3 Automatic is the only air filter designed to give the *double protection* of double filter curtains—the first wet, the second dry. There's never oil entrainment and the cleaned side of curtains is always on the filtered air side. Staynew Model A-3 Filters are designed for both light dust load installations and for heavy duty industrial service where large volumes of air are to be filtered.

Automatic Self Cleaning Type Filter

- Highest efficiency of any mechanical type automatic filter.
- Exceptionally large dust holding capacity.
- Absolutely no oil entrainment in air stream.
- Motor and control unit mounted on clean side of filter.
- Combination gear and roller chain drive (no belts to slip).

Bring your filtration problems to Staynew. If the filtration of large volumes of dirty air at high efficiency and low cost is required, let the Dollinger engineers show you how and why Staynews are your answer. Write for descriptive folder.

Representatives in Principal Cities

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

# DOLLINGER CORPORATION

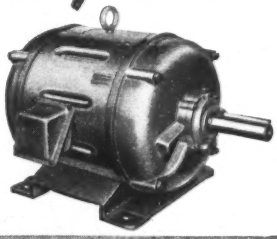
9 Centre Pk., Rochester 3, N. Y.

ALL TYPES OF FILTERS FOR EVERY INDUSTRIAL NEED

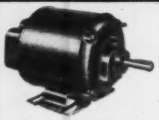
**Wagner**
**ELECTRIC MOTORS**
**...the choice of leaders in industry**

# Wagner Quality Motors *for your product or your plant*

When you select a motor from Wagner's complete line, you get a motor that is completely dependable in its specific application. You can choose from a wide variety of types and sizes. Here are a few of the motors in the Wagner line. At right is TYPE RP—open type polyphase squirrel-cage motor. It is drip-proof and suitable for all general purpose applications. 1/6 to 400 hp.

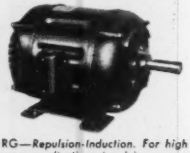


## SINGLE-PHASE

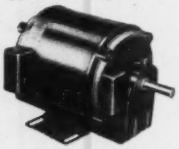


TYPE RB—*Split-phase Induction. For easy starting applications with high starting current. 1/20 to ½ hp.*

TYPE RK—*Capacitor-Start Induction. For general purpose applications requiring high starting torque—normal starting current. 1/6 to 3 hp.*

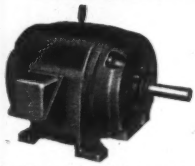


TYPE RG—*Repulsion-Induction. For high starting torque applications involving a very long starting period. 1 to 5 hp.*

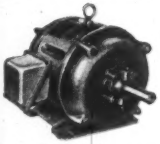


TYPE RA—*Repulsion-Start Induction. For general purpose applications with high starting torque—low starting current. ½ to 15 hp.*

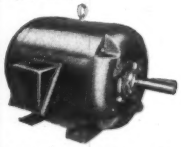
## POLYPHASE MOTORS



TYPE XP—*Splashproof. Protected against splashing or dripping liquids. ¾ to 200 hp.*

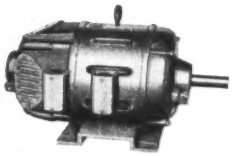


TYPE TP—*Totally-enclosed, non-ventilated. Fully protected. ¼ to 15 hp.*

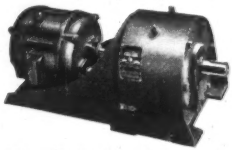


TYPE CP—*Totally-Enclosed Fan-Cooled. Protected against dirt, chips, abrasives or fumes. Steel frame. 1 to 250 hp. Also in explosion proof type HP.*

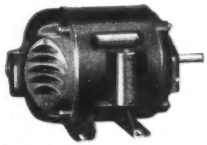
TYPE EP—*Corrosion-resistant Totally-Enclosed Fan-Cooled. Cast iron frame. 2 to 250 hp. Also available in explosion proof type JP.*



TYPE RS-1—*Wound Rotor. Constant or adjustable varying speed. 1 to 250 hp. TYPE RS-2 for intermittent service. 2 to 200 hp.*



GEAR MOTORS—*Single-phase or Polyphase. Open or enclosed types. 1/20 to 50 hp.*



DIRECT CURRENT MOTORS—*Companion line to Wagner A.C. Motors. 1/6 to 3 hp.*

* * *

In addition to a complete line of motors, Wagner also furnishes Increment Type Motor and Starter Combinations, Jet Pump Motors and a complete line of Transformers: Dry-type, Distribution and Power. Wagner engineers welcome an opportunity to serve you. Consult the nearest of 32 Branch offices, or write direct.

**Wagner Electric Corporation** EST. 1891

**WAGNER ELECTRIC CORPORATION**
**6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.**

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

**BRANCHES IN 32 PRINCIPAL CITIES**

MJ33-9

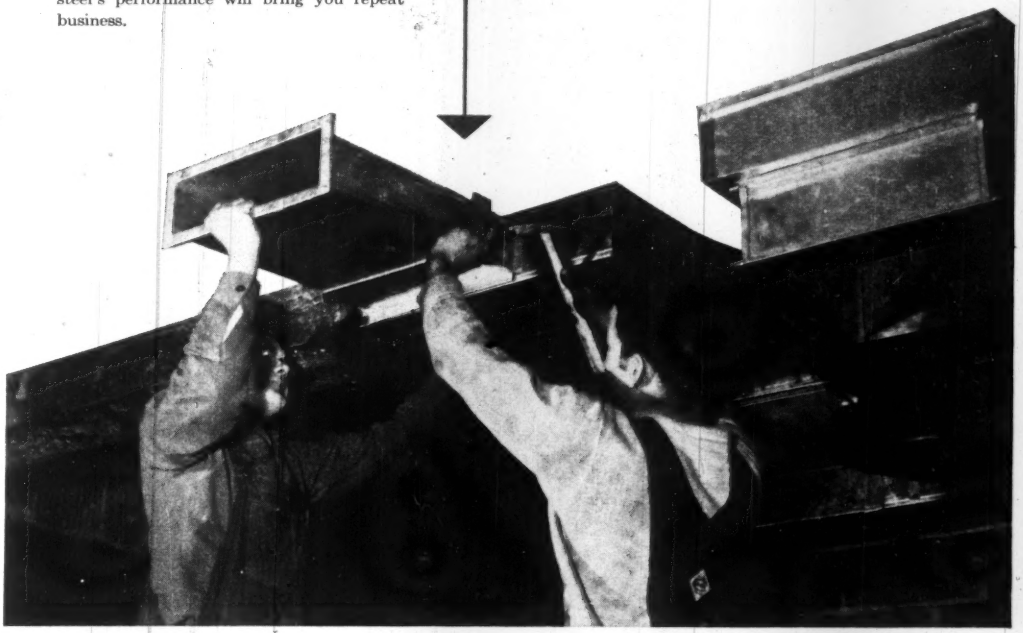
## YOUR QUALITY DUCTWORK JOBS CALL FOR

# U·S·S GALVANIZED STEEL

● You can give your customers the most satisfactory ductwork installations by using a material that combines good fabricating qualities with the strength and durability that assure long life. That material is U·S·S Galvanized Steel Sheets.

You can bend, roll, cut or stamp these galvanized steel sheets in minimum time with satisfactory results. Soldering is no problem. And steel, protected by a coating of zinc, will last and last.

For jobs that mean satisfied customers, use U·S·S Galvanized Steel Sheets. The U·S·S name assures customers they are getting high-quality steel sheets, protected with a uniformly applied coating of zinc. It's a name they know and recognize, and the steel's performance will bring you repeat business.



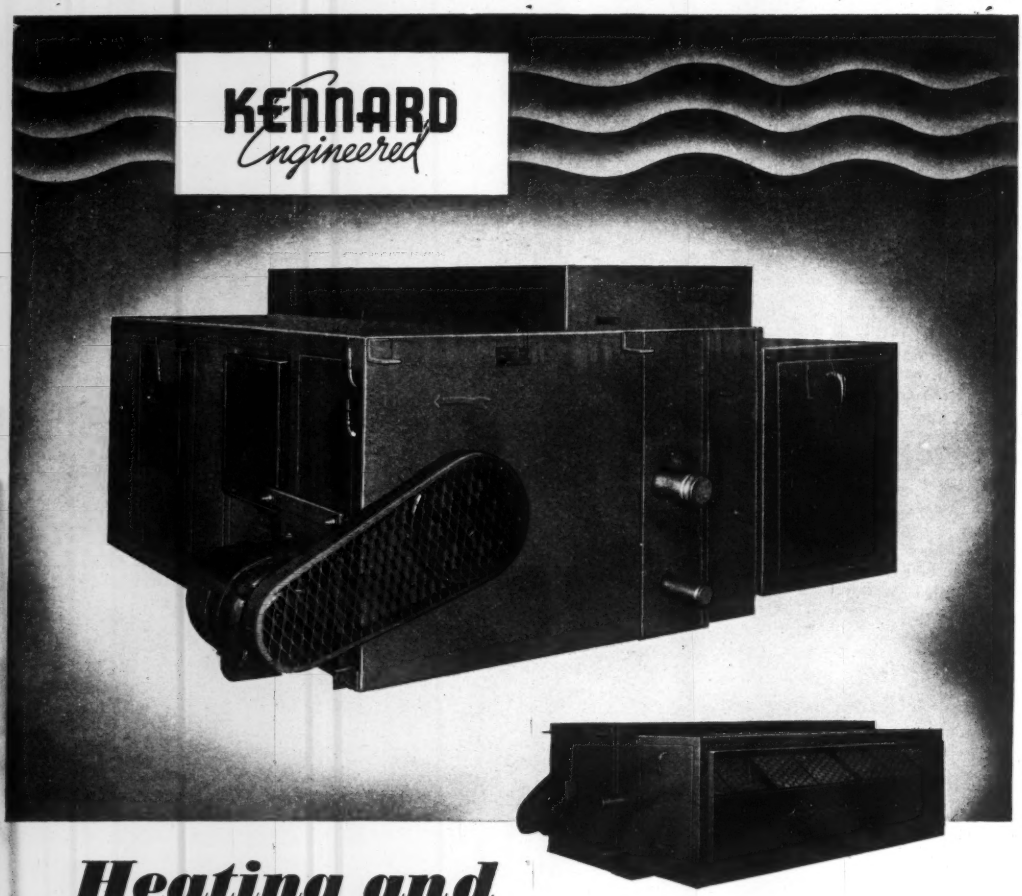
## U·S·S GALVANIZED STEEL SHEETS

UNITED STATES STEEL COMPANY, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

2-167

UNITED STATES STEEL

KENNARD
Engineered



# Heating and Ventilating Units

## Air Volumes from 400 to 21,000 CFM

Kennard Heating and Ventilating Units are the answer to requirements of heating and filtering recirculated air, fresh air, a mixture of both, or for ventilation only. These ruggedly constructed and easily installed units, conventionally used for heating large spaces or as a central station unit to heat many small rooms, can also be utilized for a variety of special and process applications.

Wall - Floor - Ceiling Mountings

Pre-heat and Re-heat Coils - 1.1 to 32.5 sq. ft. face.

Moderate tip speeds and outlet velocities

**Optional Equipment**

Mixing Box and Dampers • Face and By-pass Dampers • Throwaway, Cleanable or High Velocity Filters • Target, Grid or Pan Humidifiers.

***Representatives in Principal Cities***

*Write for name of nearest representative and complete information on Air Conditioning Blower Units—Finned Coils—Evaporative Condensers—Cooling Towers—Sprayed Coil Dehumidifiers—Multi-Zone Air Conditioning Blower Units.*

**KENNARD CORPORATION • 1817 S. HANLEY ROAD ST. LOUIS 17, MO., U.S.A.**

# THRUSH Heating Manual

FORTY FACT FILLED PAGES

## Radiant Heat WITH FORCED CIRCULATING HOT WATER

HERE'S valuable help for you! Designing and installing forced circulating Thrush Flow Control Hot Water Heat is greatly simplified by the many diagrams and tables contained in this book. It has been improved and expanded to nearly double its previous size with a large section on radiant heating engineering. Various zoning methods are fully described. One-pipe and two-pipe flow control systems are illustrated and designed step by step for further simplification. The book is in four parts. Boiler details are featured with appropriate wiring diagram shown for each installation. Capacity tables are presented in new form for sizing of mains, branches and selection of Thrush Equipment. Domestic water installations, unit heater hook-ups and even snow melting applications are covered. Installation of the complete Thrush Flow Control System has always been simple and easy, but now you will find it easier than ever. The forty fact-filled pages of this new Thrush Manual will be invaluable to you on every hot water job you install.

If you are not now installing Thrush Equipment, it is time to get acquainted. See your wholesaler or ask for more information on the coupon.

**mail this coupon**

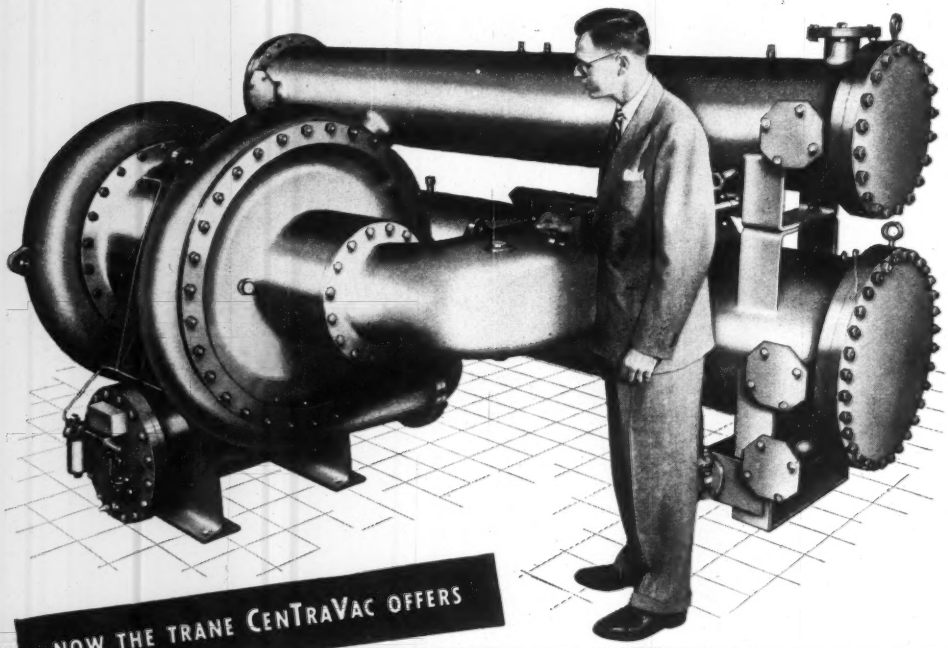
**H. A. THRUSH AND COMPANY**

Department E-2, Peru, Indiana

- ☐ We are using Thrush Equipment. Please send us your new, simplified Engineering and Installation Manual.
- ☐ We have not been users of Thrush Equipment but would like to have your literature.

NAME _____

ADDRESS _____



NOW THE TRANE CENTRAVAC OFFERS

# Centrifugal Refrigeration for the Small Job, Too

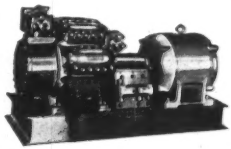
Now air conditioning installations as small as 45 tons can have all the advantages of centrifugal refrigeration. For years the flexibility, the safety and the economical operation of the centrifugal compressor were limited to the larger job. But Trane has changed all that with the CenTraVac.

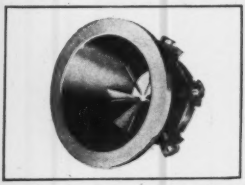
The CenTraVac is a completely self-contained, hermetically sealed water chilling unit. Light in weight—small sizes weigh under 15,000 pounds. It can be installed in basement or penthouse, in new or existing buildings. No special bases are necessary. Only simple water and electrical connections are required. First costs are surprisingly low. Push button operation eliminates the need for extra attendants —thus, maintenance costs are kept at a minimum.

Operating efficiently over a range from 100 to 10% of rated capacity, the Trane CenTraVac is ideal for the small job—industrial offices, precision manufacturing areas, small theatres, post exchanges. Yet, the CenTraVac is equally at home on the larger installations. It is available in five sizes to 190 tons. Single or multiple installation may be made. For more details, contact the Trane representative in your area or write for CenTraVac Bulletin S-399.

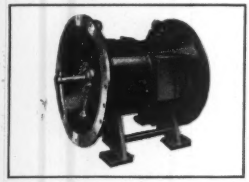
**Trane Builds Both!**

For applications in the 10 to 50 ton range, Trane manufactures a complete line of reciprocating compressors and condensers. These smooth, quiet operating units pack maximum capacity in a minimum of space.

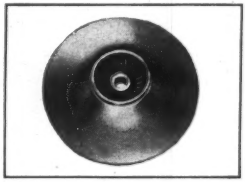




**Saves Power**—The exclusive Trane capacity control feature. Variable inlet guide vanes permit the unit to operate down to 10% of its rated capacity by regulating the flow of refrigerant into the impeller.



**No Shaft Seals**—Impellers mounted on a double extended shaft motor are hermetically sealed in this unit. Air, enemy of capacity, is sealed out. Maximum effectiveness is maintained at all times.

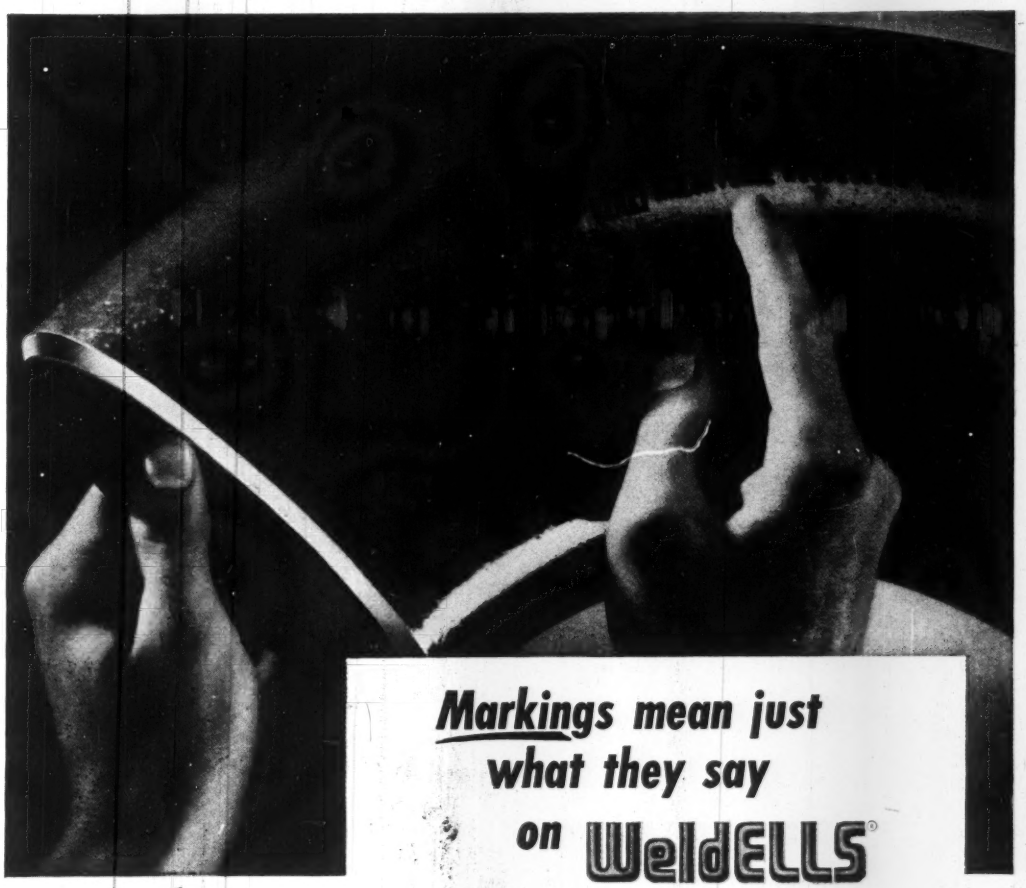


**High Efficiency**—True radial blade impellers produce flat characteristic curve—so desirable in centrifugal compressors. Curved buckets at each blade entrance also contribute to high efficiency.

**TRANE**

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
Eastern Mfg. Division . . . Scranton, Pa.
Trane Company of Canada, Ltd., Toronto
OFFICES IN 80 U. S. AND 14 CANADIAN CITIES



# Markings mean just what they say on WeldELLS®

**A VOLUME OF USEFUL DATA ON A SINGLE SHEET**—Sizes, thicknesses and dimensions of all commonly used WeldELLS and Taylor Forged Steel Flanges ingeniously condensed on a heavy durable, letter-sized card. Indispensable for piping men. Coupon brings free copy.

No other fittings for pipe welding are so true to their markings as WeldELLS — so absolutely uniform, mechanically, metallurgically, dimensionally.

It would be bad business for us to say this if thousands of users had not already said it for us and to us. "There are no bad ones" is nearly always the foremost reason given by practical men for insisting on WeldELLS.

Pick up any WeldELL and check it against the tabulation of its size, wall thickness, and other dimensions. It will be right on the head. And it will be right on the head in plus-value features, too—features that are combined in no other fittings.

Remember that the finest line of welding fittings is also the broadest line. Coupon brings your copy of useful data described below.

TF

**TAYLOR FORGE**

**TAYLOR FORGE & PIPE WORKS**

General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send a copy of your data sheet covering Taylor Forge Welding Fittings and Forged Steel Flanges.

NAME_____

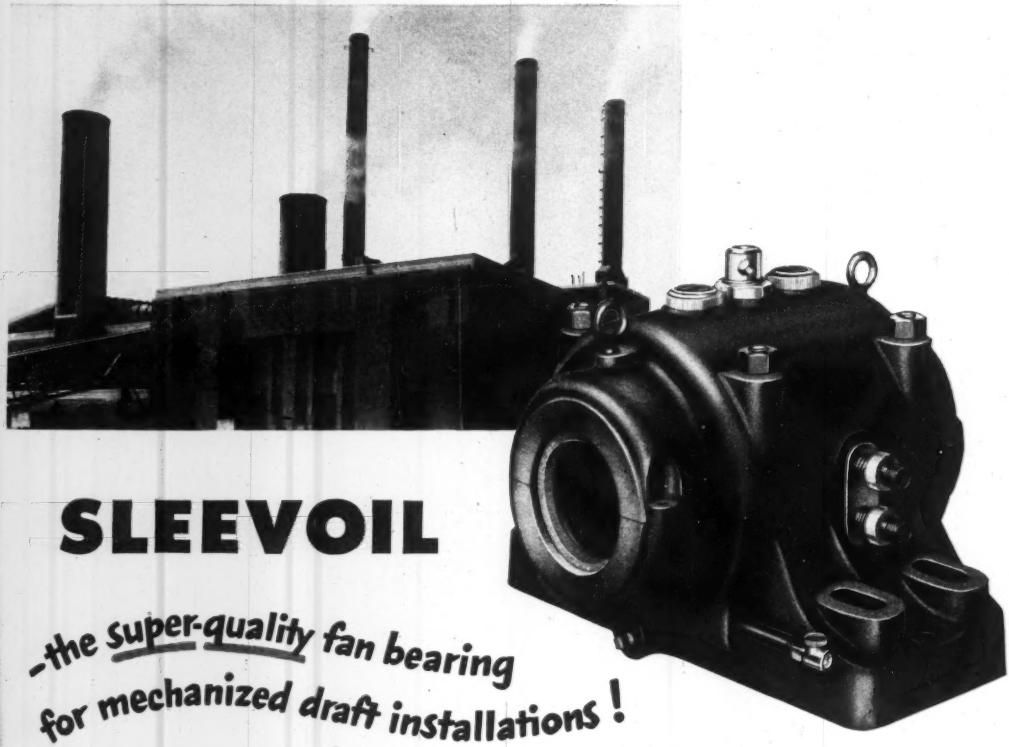
POSITION_____

COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE___ STATE_____

510-0252 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.



# SLEEVOIL

## -the super-quality fan bearing for mechanized draft installations!

● Hundreds of generating plants in America run on Dodge Sleevoil Bearings. These famous bearings combine quietness, long life and dependability to a degree unique in the bearing field. They offer engineers of costly power plants a priceless safeguard for their equipment.

Sleevoil Bearings are a Dodge development—created especially to meet the exacting requirements of fan and blower service. They are ideal bearings for important installations calling for induced or forced draft. Designed in cooperation with engineers of leading fan and blower manufacturers, they have a long record of dependable performance in critical service.

Dodge Sleevoil Pillow Blocks are normally available from stock—in both plain and water-cooled types, in shaft sizes from 1-7/16" to 8". Write us for information.

**DODGE MANUFACTURING CORPORATION**
**1600 Union Street, Mishawaka, Indiana**

**DODGE**
*of Mishawaka, Ind.*

**CALL THE TRANSMISSIONEER,** your local Dodge Distributor. Factory trained by Dodge, he can give you valuable assistance on *modern* power transmission machinery for *modern* installations. Look for his name under "Power Transmission Equipment" in your local classified phone book.

**FIRST IN POWER TRANSMISSION MACHINERY!**

SEALED-LIFE V-BELTS; TAPER-LOCK SHEAVES

TORQUE-ARM SPEED REDUCERS

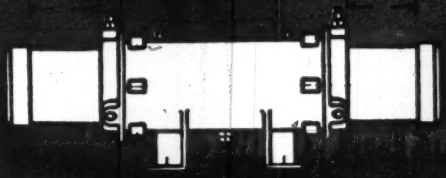
DODGE-TIMKEN PILLOW BLOCKS

ROLLING GRIP AND DIAMOND D CLUTCHES

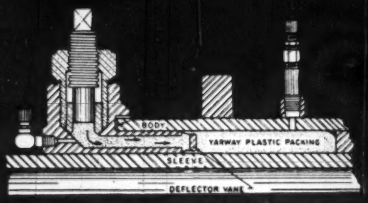
NAME PLATES

**FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS**

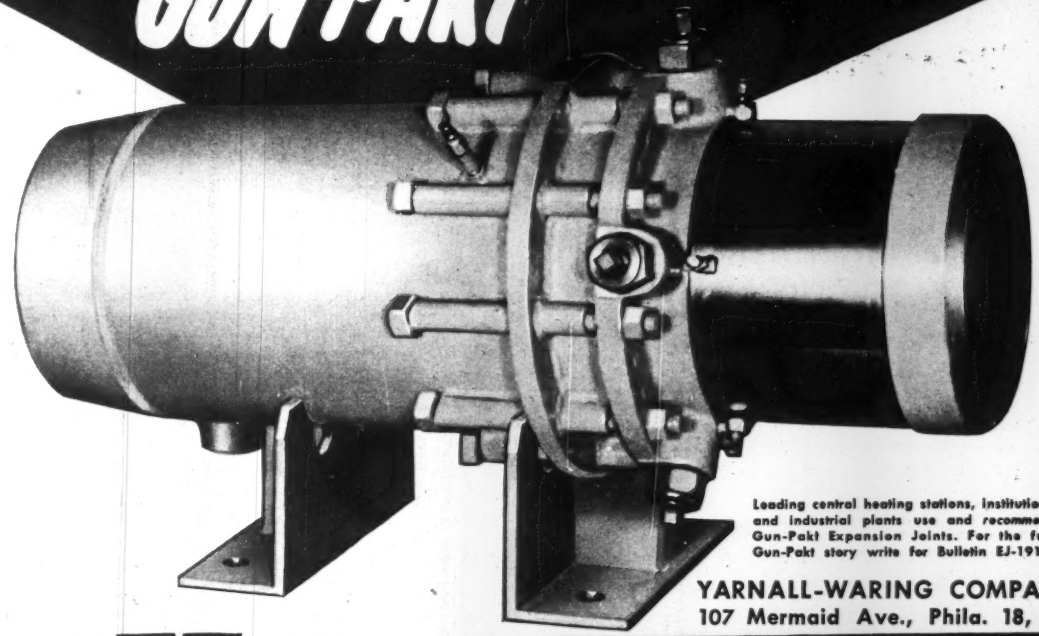
# YOU NEED FEWER JOINTS



## AND LESS MAINTENANCE




# W GUN-PAKT ints



Leading central heating stations, institutions and industrial plants use and *recommend* Gun-Pakt Expansion Joints. For the full Gun-Pakt story write for Bulletin EJ-1912.

**YARNALL-WARING COMPANY**
107 Mermaid Ave., Phila. 18, Pa.

**YARWAY** GUN-PAKT EXPANSION JOINT

# Century 1 TO 400 H.P. MOTORS

## Choose From These Many Types To Fit Your Job

**DEPENDABLE CONSTRUCTION . . . Plus**
**PROPER SELECTION MINIMIZE SHUTDOWNS**

**It's easy to select the proper electric motor for your job from Century's complete line — from 1/8 to 400 horsepower. A wide range of types of kinds are available to satisfy all popular requirements. They are carefully designed, built and tested to assure maximum performance throughout their long life.**

***Here are examples of Century's line of INTEGRAL HORSEPOWER motors.***

*Polyphase*

**TYPE SC**—Open Drip proof General Purpose Motor. Meets the needs of most installations where operating conditions are relatively clean and dry.

**TYPE SC**—Splash proof. Supplies protection where plants must be washed down. Keeps out all falling or splashing liquids—rain, snow, sleet, etc.

**TYPE SC**—Totally Enclosed Fan Cooled. Protects against dusts, mist, oil, fog. Inner frame protects vital parts of the motor, seals out harmful matter.

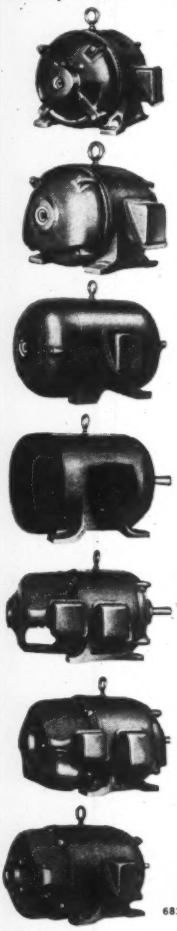
**TYPE SC**—Explosion proof. Protects life and property in atmospheres charged with explosive dusts or gases.

**TYPE SR**—Wound Rotor. Open Construction. Ideal for applications requiring low starting current with high starting torque, reversing or adjustable speed.

**TYPE SR**—Wound Rotor Splash proof. Same electrical characteristics as motor shown above. In addition, gives adequate protection against falling and splashing liquids.

*Single Phase*

**TYPE RS**—Repulsion Start Induction, Open Construction, Single Phase Brush Lifting Motor. Combines high starting torque with low starting current.



683

**TYPE RS**—Splash proof. Same advantages as open construction, plus protection against splashing and falling liquids.

**TYPE CSH**—Capacitor Start Induction, Single Phase Motor. Suitable when high starting torque with normal starting current is satisfactory.

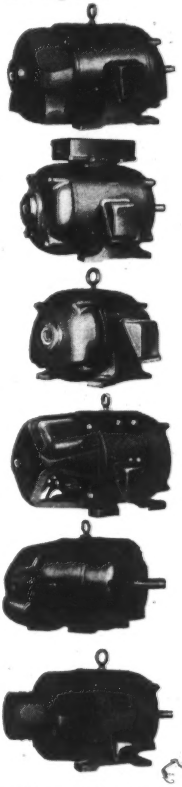
**TYPE CSH**—Splash proof. Same advantages as motor shown above, plus protection against falling and splashing liquids.

*Direct Current*

**TYPE DN**—Direct Current Motors. Suitable for use where direct current is available, or its use desirable.

**TYPE DN**—Direct Current, Splash proof.

**TYPE SY**—Synchronous. Suitable for continuous operation at a uniform load for power factor correction.



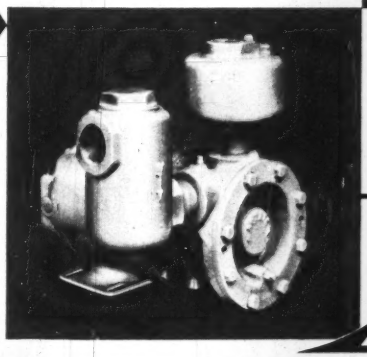
**In addition to a complete line of integral horsepower motors, Century offers fractional horsepower motors, gear motors, generators, AC and DC motor generator sets.**

**For a long life of satisfactory performance, specify Century motors for all your electric power requirements.**

**CENTURY ELECTRIC COMPANY,** 1806 Pine Street, St. Louis 3, Missouri • Offices and Stock Points in Principal Cities

# This IS THE DIRECTION TO GO IF YOU'RE LOOKING FOR THE TOPS IN PUMPS

SELF-PRIMING
TYPE TVE
CLOSE-COUPLED
ELECTRIC DRIVE



**CHARACTERISTICS AT A GLANCE**

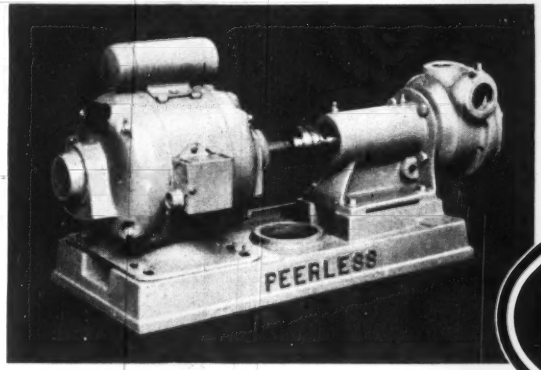
**CAPACITIES:** Up to 58 gpm at 3500 rpm — Up to 36 gpm at 1750 rpm.

**HEADS:** Up to 800 feet at 3500 rpm — Up to 300 feet at 1750 rpm.

**MOTOR SIZES:** Up to 20 hp at 3500 rpm — Up to 7.5 hp at 1750 rpm.

**TEMPERATURE RANGE:** Type TVE, up to 212°F — Type TVB, up to 250°F.

TYPE TVB
FLEXIBLE-COUPLED
ELECTRIC DRIVE




## PEERLESS TURBINE VANE PUMPS

## PEERLESS PUMPS

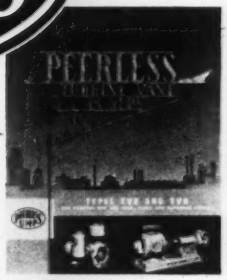
### PEERLESS OFFERS THE COMPLETE LINE OF EASY TO UNDERSTAND—EASY TO APPLY TURBINE VANE TYPE ALL PURPOSE PUMPS

Use Peerless Type TVE and Type TVB vane pumps for pumping clear liquids in moderate capacities against medium and high heads. They are excellent for handling hot or cold, clear and vaporous liquids. A wide selection of types and sizes allows them to fit into most all piping and pumping layouts. They're compact, sturdily-built, dependable and good looking. You'll find them easiest to apply, install, connect and maintain. Disassembly and assembly of pump liquid end for inspection, repair or replacement is done in a matter of minutes. Standard materials are cast iron case, bronze impeller and liners, stainless steel shaft and a standard mechanical shaft seal. Choose the type that meets your requirements from Peerless' complete line of standard or self-priming models.

*PEERLESS BUILDS DEPENDABLE PUMPS*

**NEW BULLETIN**

Peerless Bulletin No. B-2205 is so comprehensive that you can make your selection of the right pump for your job from this bulletin. Mail coupon today for your copy.




PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us copy of Peerless Turbine Vane Pump Bulletin No. B-2205.

NAME _____

COMPANY _____

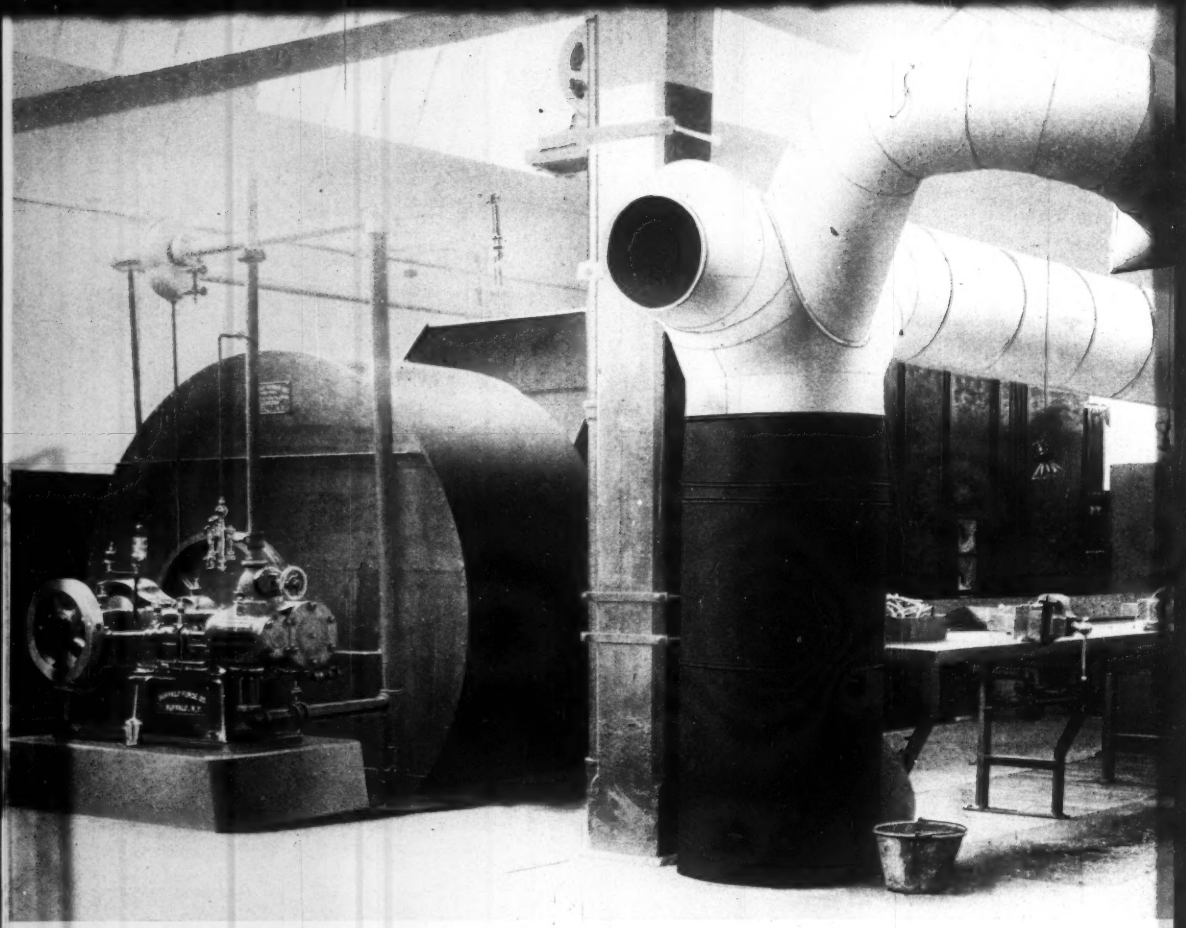
STREET _____

CITY _____ STATE _____

HP & AC

**PEERLESS PUMP DIVISION**
**FOOD MACHINERY AND CHEMICAL CORPORATION**
*Address inquiries to Factories at*
**Los Angeles 31, California and Indianapolis 8, Indiana**
Offices: New York, Chicago, St. Louis, Atlanta; Dallas, Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, N.M.; Tulsa.

PEERLESS PUMPS fmc



*This engine driven "Buffalo" Fan and Air Washer was a typical installation about fifty years ago.*

# "Buffalo" Heating,

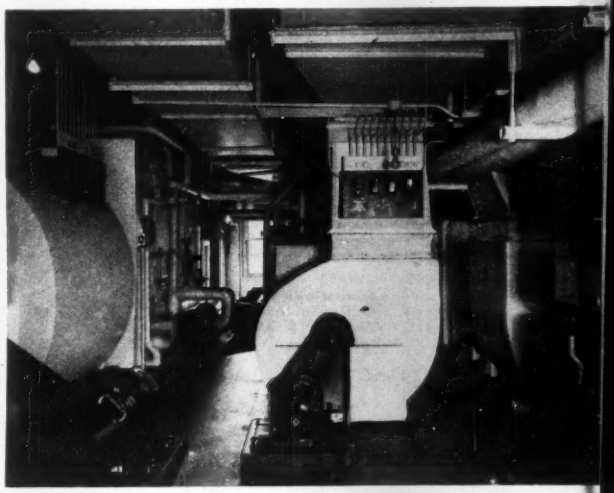
# Air Condi

# —from the beginning

From the very earliest days of comfort cooling back in 1895, when melting ice and "Buffalo" Fans cooled parts of the Auditorium Hotel in Chicago, Buffalo Forge Company has constantly kept pace with the ever-growing demand for better and more efficient heating, ventilating, air handling and air conditioning equipment.

During the past 57 years, "Buffalo" equipment has made millions of people more comfortable, and manufacturing operations more efficient. Practically every industry has benefited — textiles, tobacco, printing, foods, automotive, aircraft, chemicals, theatres, department stores and many, many others.

BUFFALO FORGE COMPANY
171 Mortimer Street, Buffalo, New York
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities



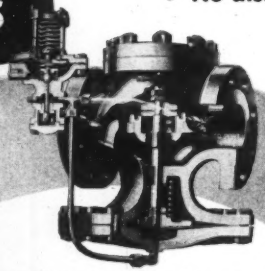
*These modern insulated "Buffalo" Fans and Air Washers are typical of today's best practice.*

# Ventilating and tioning Equipment

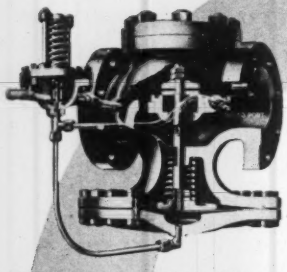
# SAVE WITH SPENCE on all these jobs

***Here are a few reasons why Spence Regulators give you accurate regulation and long, trouble-free life:***

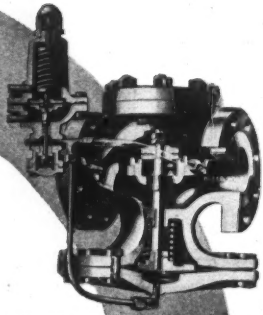
- **Single-seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**



**PRESSURE REDUCING**—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes ¼ in. to 12 in. Pressures to 600 psi 750 F.

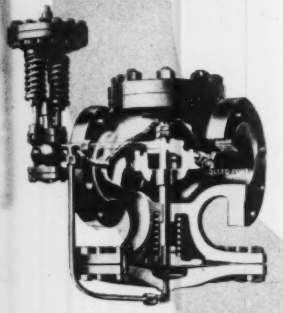


**BACK PRESSURE CONTROL**—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.

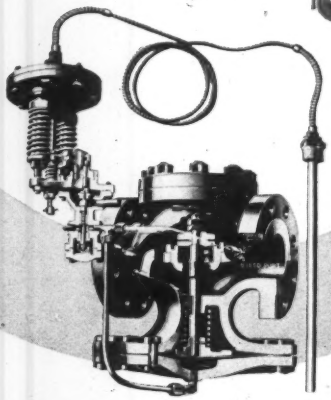


**DIFFERENTIAL PRESSURE**—Accurate control of delivery pressure at a constant, adjustable differential from 3 to 150 psi above another source of fluid pressure.

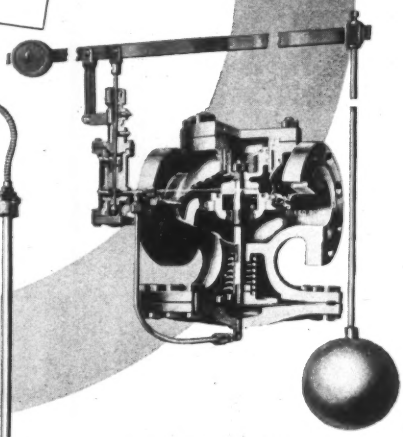
**WRITE FOR BULLETIN 350**
*for complete details on Spence's line of automatic regulating valves*



**PUMP GOVERNOR**—Constant or excess pressure control for steam pumps. Steam pressures to 600 psi 750 F, pump discharge pressures to 2000 psi.



**TEMPERATURE REGULATING**—Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.



**LEVER OPERATED**—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

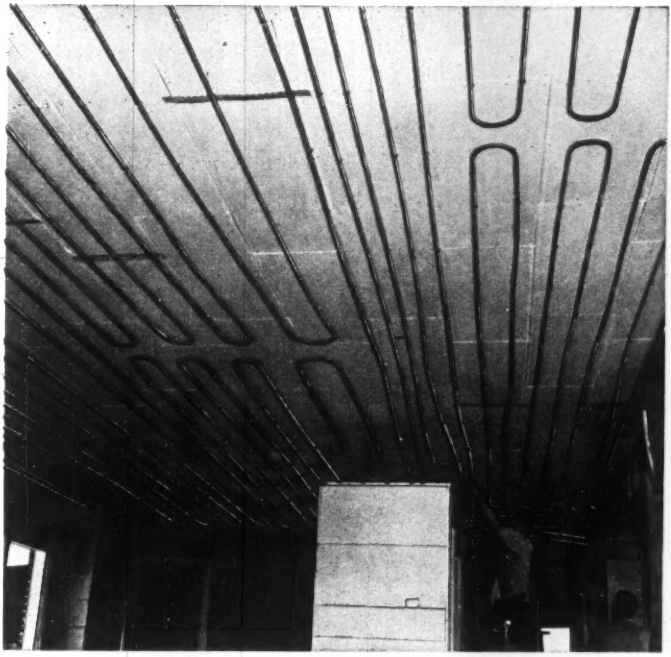
SE-113

**SPENCE ENGINEERING COMPANY, INC.**
**WALDEN, NEW YORK**

Spence

# Better radiant heating systems, measurable savings with Bundyweld Tubing

You want better radiant heating systems. You want them at every saving in fabrication cost and installation time you can possibly get. Then choose Bundyweld Tubing and realize both goals. See for yourself:



It is the conviction of Bundy Tubing Company that radiant heating grids rightly belong in ceilings. Among other advantages, *ceiling* installations provide proper floor warmth without danger of discomfort, respond far more quickly to thermostat demand, give a far *higher* percentage of radiant heat.

**Performance:** Bundyweld is leakproof. It has great bursting strength. It conducts heat quickly. Bundyweld is scale-free and clean, with uniform I.D. and O.D. for trouble-free, even water flow.

**Fabrication and Installation:** Standard 20′ lengths of Bundyweld (one end expanded when specified) are trucked and handled easily, yet minimize number of joints in completed systems. Ductile Bundyweld bends easily to short radii without danger of structural collapse. Two or more formed, lightweight grids can be quickly joined, easily positioned. No crushing, denting, sagging; no scrapped tubing.

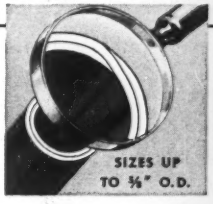
**Construction:** Bundyweld is the *only* tubing double-walled from a single strip, with inside and outside beveled edges. It's copper-brazed through 360° of wall contact, copper-coated inside and out. It can also be furnished with a lead-tin coating. For free brochure, write Radiant Heating Division, ***Bundy Tubing Company, Detroit 14, Michigan.***

# Bundyweld® Tubing

**DOUBLE-WALLED FROM A SINGLE STRIP**

**WHY BUNDYWELD IS BETTER TUBING**

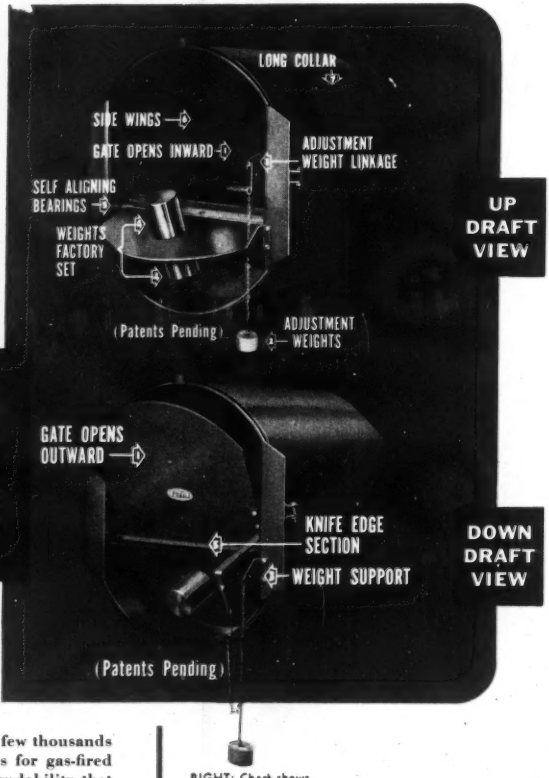
**Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness, and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld steel tubing, double-walled, and brazed through 360° of wall contact.**




**NOTE the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.**

# Now... a Field BAROMETRIC DRAFT CONTROL FOR COMMERCIAL & INDUSTRIAL

# GAS FIRED HEATING PLANTS



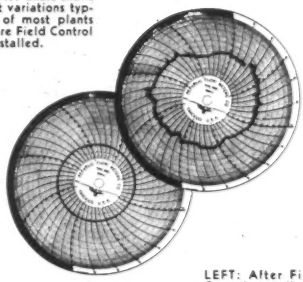

## (Not yet available in domestic sizes)

The Field "M-G" Double Acting Draft Control brings greater efficiency, greater economy to gas fired heating plants through extremely accurate control of drafts. The double-acting gate opens inward to regulate up-drafts, and outward to relieve internal or down-draft pressures as small as a few thousands of an inch. This newest Field Draft Control provides for gas-fired heating plants the same accuracy, sensitivity and dependability that have made Field Draft Controls first in the coal and oil-fired fields. Write today for detailed specifications.

**FIELD CONTROL DIVISION**
of H. D. Conkey & Company, MENDOTA, ILLINOIS

In case of prolonged down draft or blocked flue, an optional auxiliary switch can be mounted on the control and wired to shut off the burner, thus providing protection against the escape of carbon monoxide into the building.

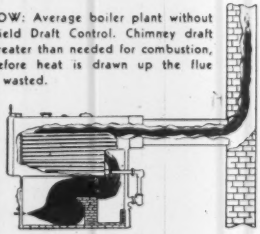
RIGHT: Chart shows draft variations typical of most plants before Field Control is installed.



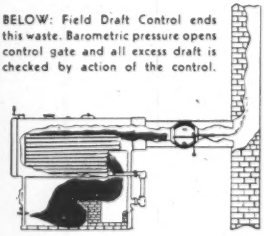
LEFT: After Field Control installation the breeching draft is held constant.

## Why a Field Draft Control:

BELOW: Average boiler plant without a Field Draft Control. Chimney draft is greater than needed for combustion, therefore heat is drawn up the flue and wasted.

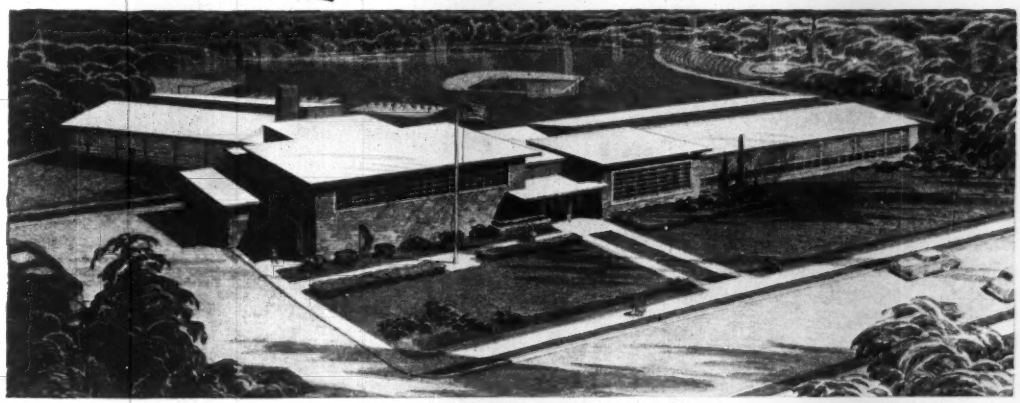


BELOW: Field Draft Control ends this waste. Barometric pressure opens control gate and all excess draft is checked by action of the control.

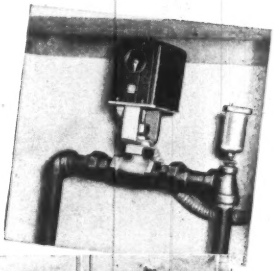


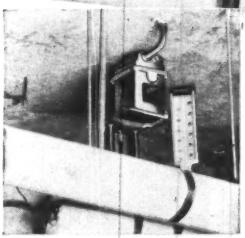
CONTROLLED DRAFT BY Field BAROMETRIC CONTROLS

# THE A B C OF PROPER *Automatic* TEMPERATURE CONTROL



OAKRIDGE SCHOOL, ARLINGTON, VIRGINIA
ARCHITECTS: Allen J. Dickey & John Graham, Jr. Arlington, Va. ENGINEER: A. Dee Counts. Washington, D.C. HEATING CONTRACTOR: W. J. Baumbach, Inc., Arlington, Va.





Above, Barber-Colman Motor-Operated Valve as installed on the hot water supply to each room.

Below, Barber-Colman Motor-Operated Valve on the steam supply to converter in the boiler room.

## ALWAYS BARBER-COLMAN

THIS is *fundamental* with experienced heating and ventilating engineers: the A B C fact that Barber-Colman controls are at the top of the roll-call.

In the modern Oakridge School at Arlington, Virginia, Controls by Barber-Colman were installed to provide a good, efficient, heating and ventilating system with flexibility. Panels supply a steady, even flow of warmth with no drafts. Rooms are grouped by zones with a fan system in each zone to assure a constant flow of filtered, tempered air for ventilation and maximum comfort. Fans are shut down at night.

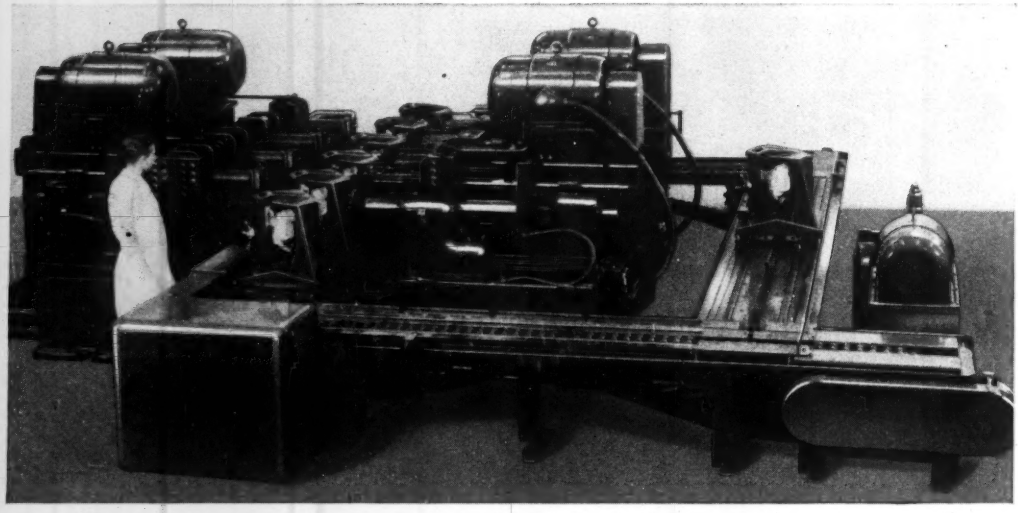
Water temperature, from the converter on the oil-fired steam boiler, is varied automatically by an outdoor reset thermostat. Individual room temperature is kept constant and over-runs avoided by use of anticipating thermostats and motor-operated valves. Since system supply water temperature varies with outdoor temperature, corridors are kept comfortable with minimum heat losses without use of valves and thermostats.

So, once again Barber-Colman Controls make possible a simple, cost-saving heating system. For detailed information on Barber-Colman Controls, write for Bulletin F-2287-3.

BARBER COLMAN

NATION-WIDE SALES AND ENGINEERING SERVICE

**BARBER-COLMAN COMPANY, 1228 ROCK ST., ROCKFORD, ILL.**



Cross Transfer-matic, with 10 Howell motors, helps speed aircraft production.

# Drills, bores 80 cylinder heads per hour!

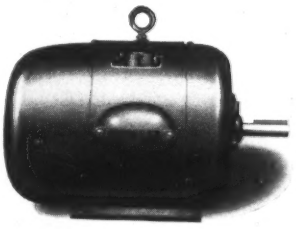
This Cross Transfer-matic drills and bores 80 aircraft engine cylinder heads per hour! That means a lot of engines for military or civilian planes.

Built for one of the industry's leading manufacturers, this machine automatically rough drills and forms valve pockets and spring compartments, and finish bores valve guide holes and valve insert and spring seats. The whole operation takes only 45 seconds!

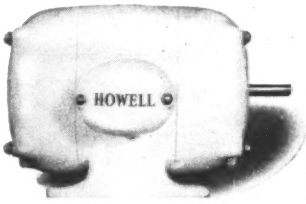
Ten precision-built Howell motors, ranging in size from one to 30 H.P., were specified to drive the spindles, the hydraulic and coolant pumps, and the chip and fixture conveyors. Each Howell motor was chosen to fit its job exactly.

Howell engineers will be glad to work with you, too, to get top performance from your electric motor installations. They will design special motors if required, or recommend Howell motors in standard NEMA frame sizes from 1/6 to 200 H.P. So, for every job, especially your toughest ones, get in touch with the Howell representative in your city, or write directly to us today.

**HOWELL ELECTRIC MOTORS COMPANY**
**Howell, Michigan**



HOWELL Type K Motor. Offers constant performance in the presence of dirt, dust, fumes and moisture. Sizes from 3 to 150 H.P. at 1800 R.P.M. Either vertical or horizontal mounting.

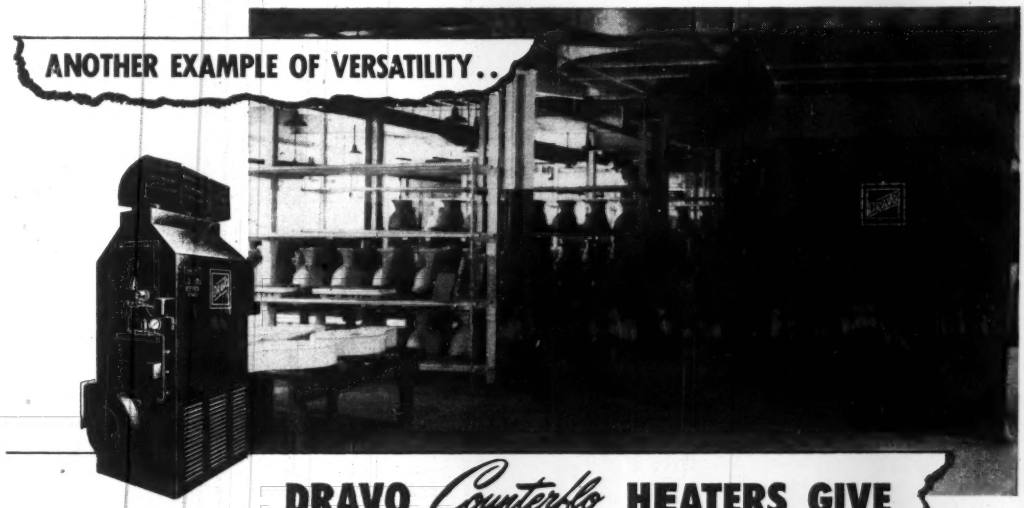



HOWELL Sanitary Motors meet the most exacting standards of the dairy and food industries. They contain no pockets, cracks, or crevices. Available for vertical or horizontal mounting.

HOWELL Red Band MOTORS

HOWELL ELECTRIC MOTORS CO., HOWELL, MICH.
*Precision-built industrial motors since 1915*

ANOTHER EXAMPLE OF VERSATILITY..



# DRAVO *Counterflo* HEATERS GIVE 3-WAY SERVICE TO ABINGDON POTTERIES, INC.

## 1. MEDIUM-TEMPERATURE PROCESS DRYING...

In the combination casting and drying rooms fifteen Dravo *Counterflo* Heaters each provide 11,000 cu. ft. of warm air per minute to dry vitreous china castings and molds, maintain constant temperature and control humidity.

## 2. TEMPERING OF MAKE-UP AIR...

Exhaust fans remove 64,000 cu. ft. of air per minute from the eight booths in the glaze spray department. Direct-fired Dravo Heaters equalize pressure by bringing in fresh replacement air and warming it to comfortable working temperatures.

## 3. COMFORT HEATING AND VENTILATING...

Abingdon's mold shop is kept at a uniform 80° F. temperature by one Dravo Heater for the benefit of workmen making plastic molds. In summertime this unit is used for ventilation.

## DRAVO HEATERS CAN SAVE YOU MONEY IN MANY PROCESS DRYING OPERATIONS

In addition to space heating, these versatile heaters can easily be adapted to nearly any type of medium-temperature process drying and curing operations, especially in farming, wood-working, textile, concrete, paper, plastic, painting and cleaning fields.

## DRAVO HEATERS OFFER YOU...

- Low initial cost... users report 30% to 60% savings.
- Low fuel consumption... burn gas or oil.
- Easily converted.
- Automatic controls... on-off or modulating.
- Long service life, low maintenance... stainless steel combustion chamber.
- Mobility... can be moved to any location.
- Flexibility... can be mounted horizontally or vertically on floor, walls or ceiling.

## WRITE FOR MORE INFORMATION

Get a complete report on how Dravo Heaters helped Abingdon Potteries with their process drying operation. Write for the complete case history, Bulletin No. RS-526-91

Listed by UL Approved by

**DRAVO** CORPORATION

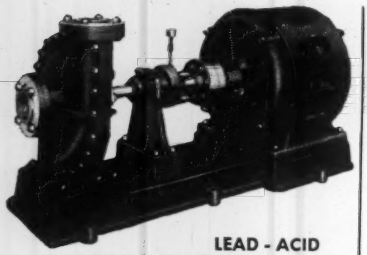
HEATING DEPARTMENT
Dravo Bldg., Fifth & Liberty Ave.
PITTSBURGH 22, PA.

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH
*Sales Representatives in Principal Cities*

DRAVO

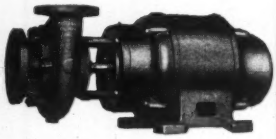
Manufactured and sold in Canada by Marine Industries, Ltd., Sorel, Quebec

Export Associates: Lynch, Wilde & Co., Washington 9, D.C.



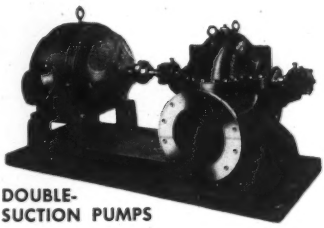
**LEAD - ACID AND OTHER CHEMICAL PUMPS**

"Buffalo" Chemical Pumps are available with lead lining like the pump shown, or rubber lined or of special alloys. Bulletin 982.



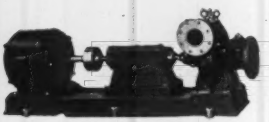
**CLOSE-COUPLED PUMPS**

A real space-saving design with no sacrifice in durability and efficiency. For clear water, but can be had in special alloys. Bulletin 975-B.



**DOUBLE-SUCTION PUMPS**

For top performance on clear water jobs, including air washers, these are of the finest materials and construction. Bulletin 955-N.



**PAPER STOCK PUMPS**

Diagonally-split-shell non-clogging pumps. A design for every liquid, every consistency, all proven in paper and pulp mills. Bulletin 953-F.

"Buffalo"

# PUMPS

## MEAN MONEY SAVED THROUGH TROUBLE AVOIDED

True economy in pumping is in the pump you can install — and practically forget! "Buffalo" has always built such pumps. First cost may be a few dollars more than the "low-bidder" pump, but careful, sound "Buffalo" design and construction has always paid for itself in (1) longer years on the job, (2) fewer and shorter shutdowns, and (3) high efficiency.

As the pictures on this page show, you can pick a "Buffalo" Centrifugal Pump that's tailor-made for just about any liquid job you have. WRITE FOR BULLETINS!

**BUFFALO PUMPS, INC.**

171 MORTIMER STREET BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

**— And For FANS . . .**

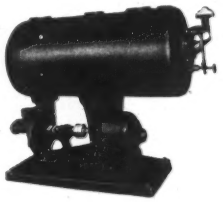
. . . you'll find a full line of centrifugal, axial flow and propeller fans in the sizes and arrangements you want — a fan for every job! For best results on your next fan installation, look to "Buffalo". . . First For Fans. For complete information, write:

**BUFFALO FORGE COMPANY**

171 MORTIMER STREET BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities



**AUTOMATIC CONDENSATE PUMPS AND RECEIVERS**

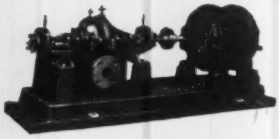
Will handle condensate at 212° F. without being affected in any way. Self-priming and trouble-proof. Bulletin 960-G.

**SUMP PUMPS**

Self-contained vertical units ready to install. Rugged, trouble-free, with ball-bearing thrust and enclosed shaft. Bulletin 963-F.

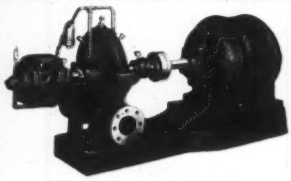
**NON-CLOGGING SEWAGE PUMPS**

Vertical and horizontal models for trouble-free operation in sludge circulation, agitation and removal, in lift stations and treatment plants. Bulletin 964-D.



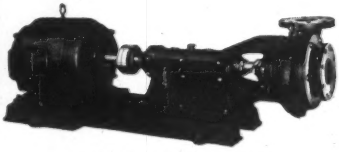
**TYPE "RR" PUMPS**

For handling clear water, any temperature, at high pressures. Widely used for boiler feed. Rugged, efficient. Bulletin 980-B.



**SELF-PRIMING PUMPS**

Positive prime is maintained at all times. A popular feature available in all "Buffalo" Double Suction Pumps. Bulletin 970-A.



**SPECIAL ALLOY PUMPS**

Single suction, full ball bearing pumps, suitable for construction in most machineable alloys. Bulletin 982.

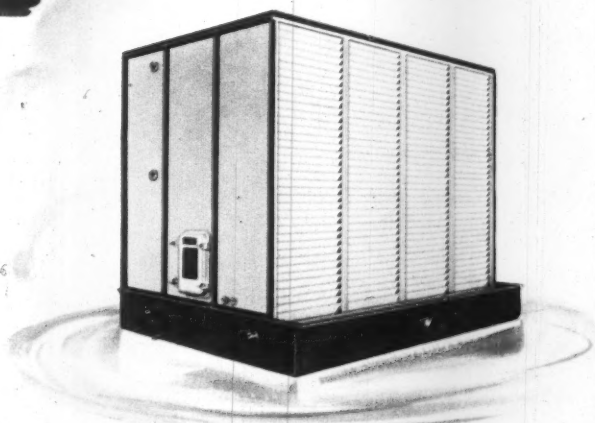
**American Blower – a time-honored name in air handling**

The hottest, dampest summer day won't bother you a bit once you've installed an American Blower Air Washer in your business.

These precision-built units cleanse and wash inside air at remarkably low cost.

Three standard classes are available: the Class 8 Air Washer and Dehumidifier, a heavy duty unit with 2 spray banks; the Class 6 Air Washer, an intermediate capacity unit with a single spray bank; the Class 4 Air Washer, a compact, economical, single-spray-bank unit designed for minimum space.

For details, ask the nearest American Blower Branch Office.



American Blower Air Washers and Dehumidifiers are available in three standard classes and in a wide range of standard sizes. Capacities from 5,550 to 117,350 cfm.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary corporation

# AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

*Serving home and industry*

AMERICAN-STANDARD • AMERICAN BLOWER • ACME CABINETS • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

# America needs your daily pound of scrap

IF every man, woman and child in America provided one pound of scrap each day, they would supply just about enough to produce the 105 million tons or more of new steel that the industry hopes to make in 1952.

Like yeast in breadmaking, scrap is essential to steelmaking. Scrap speeds up the process because scrap is already-refined steel. Every ton of scrap used replaces one ton of pig iron. Thus scrap also saves raw materials, because each ton of pig iron represents two tons of iron ore, one ton of coal and half a ton of limestone.

The continuing co-operation of every reader of this page is urgently requested to overcome a scrap shortage daily growing more critical. Turn in--by selling your scrap to regular scrap-gathering channels--any and all broken, worn-out or obsolete things made of iron and steel--machines, tools, pipe, boilers, structural parts and other "junk" you'll probably never use again.

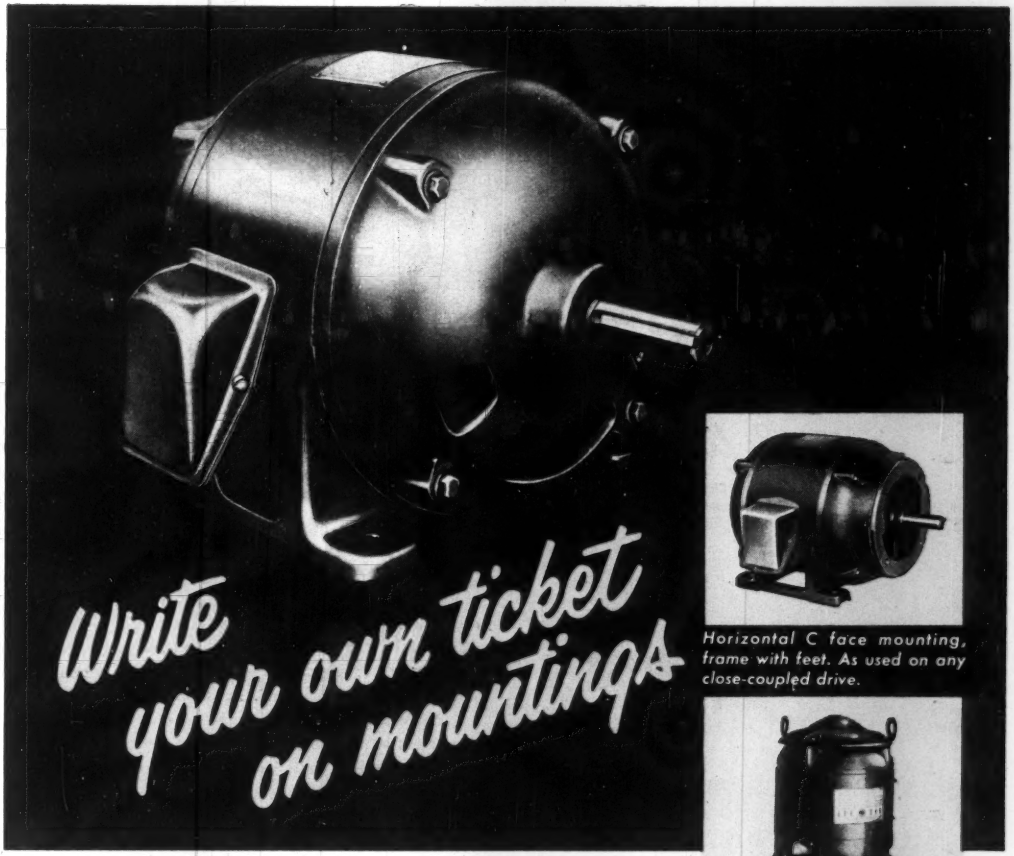
Do your part in the campaign to help meet America's need for more steel. Enlist now for the duration. Remember that the scrap you furnish may help you get more steel.

YOUR SCRAP IS NEEDED — YOUNGSTOWN

## The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

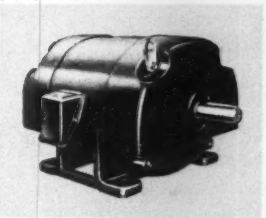
**The steel industry is using all its resources to produce more steel, but it needs your help and needs it now. Turn in your scrap, through your regular sources, at the earliest possible moment.**






*Horizontal C face mounting, frame with feet. As used on any close-coupled drive.*

*Type D flange mounting for vertical drive. Also available for horizontal application. Ideal for pump drives.*



*The splash-proof enclosure affords full protection against splashing liquids.*

# ELLIOTT Crocker-Wheeler

## PROTECTED TYPE FORM BA MOTORS

● In addition to standard horizontal mounting, you can get this motor with Type C face mounting, horizontal or vertical. You can also get it in Type D flange mounting, horizontal or vertical, with or without feet.

The standard enclosure is open dripproof, with all openings below the centerline. Also available in splashproof enclosure, as illustrated below.

The basic motor has all the Crocker-Wheeler sturdiness of double-row-width bearings, prelubricated and sealed; Vinylastic-insulated coils, Alucas: rotors and similar refinements. In NEMA frames 203 to 505 inclusive, and in ratings above. Write for the Form BA Bulletin.

**ELLIOTT Company**

**CROCKER-WHEELER DIVISION**
**AMPERE, N. J.**

BRANCH OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES

ELLIOTT *Approved* SERVICE SHOPS COVER THE COUNTRY

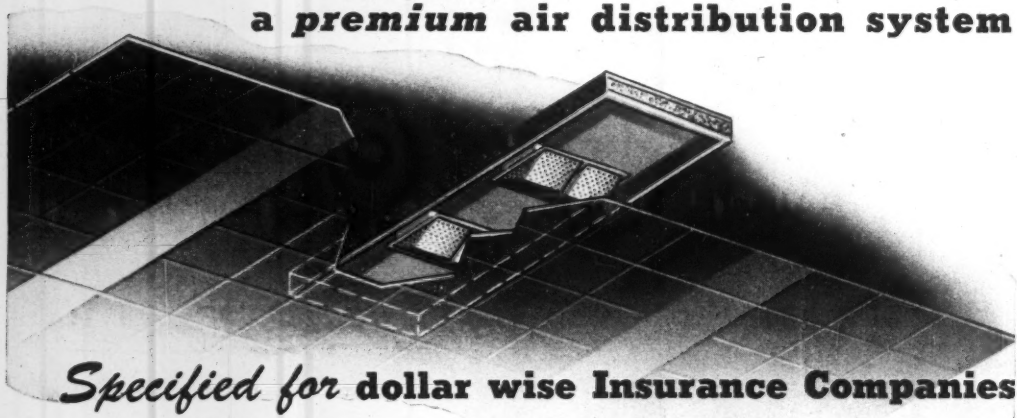
W2-1

# MULTI-VENT

T.M. Reg. U.S. Pat. Off.

*low velocity air diffusion ceiling panels*

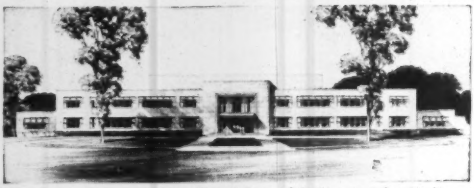
## a *premium* air distribution system



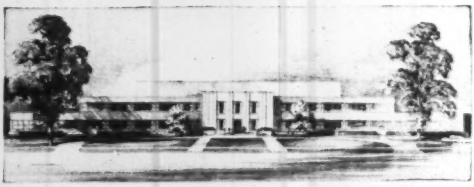
## *Specified for* dollar wise Insurance Companies

by Childs & Smith, Chicago
Architect-engineers for the four new buildings illustrated below

*Shelby Mutual Casualty Co., Shelby, Ohio*



*Farmers Mutual Automobile Insurance Co., Madison, Wisc.*



*Utica Mutual Insurance Co., Utica, N. Y.*

*Lumbermans Mutual Insurance Co., Mansfield, Ohio*

*Comfortable, complaint-free* air conditioned office spaces are an important factor in the productivity and employee relations of any company where office work plays an important role. That is why these insurance firms were readily convinced that their dollars were spent *wisely* on Multi-Vent panels for air distribution . . . a premium product which guarantees a superior, faultless performance worthy of their investment in the over all air conditioning system. For with Multi-Vent panels installed throughout, completely concealed in standard acoustical ceilings, a widespread, uniform air distribution is enjoyed free from all the hazards of drafts, noise and dirt. In addition the unique radiant panel heating or cooling effect of the Multi-Vent panel adds to the comfort factor.

Only Multi-Vent distributes air entirely by displacement rather than by high velocity injection. That means there are no strong air streams to aim and no change in air flow pattern when air supply is varied. Even with movable partitions and low ceilings, all problems of outlet location and direction adjustments for throw and drop to avoid drafts are eliminated . . . there simply are no drafts!

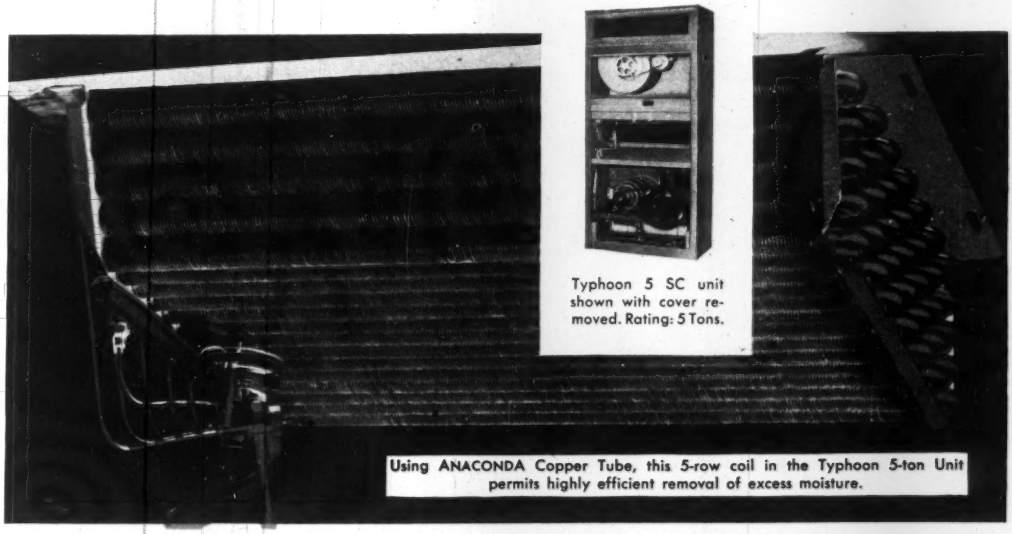
The use of Multi-Vent makes possible many sound economies in the basic heating, cooling, and air conditioning equipment in addition to substantial reductions in installation, maintenance, and redecorating costs. It pays to specify the finest in air diffusion systems . . . Multi-Vent. Write now for detailed literature and the name of the Multi-Vent sales engineer in your vicinity.

**MULTI-VENT DIVISION**

**THE PYLE-NATIONAL COMPANY**
1373 North Kostner Avenue Chicago 51, Illinois

# There's nothing like ANACONDA Tubes to cut production costs!

Several examples of the versatility of ANACONDA Copper Tube can be seen in these assorted tube bends fabricated by Typhoon Air Conditioning Company.



Typhoon 5 SC unit shown with cover removed. Rating: 5 Tons.

Using ANACONDA Copper Tube, this 5-row coil in the Typhoon 5-ton Unit permits highly efficient removal of excess moisture.

The workability of ANACONDA Copper Tubes – their uniformity of temper–that's what cuts production costs for The Typhoon Air Conditioning Co. on the generous five-row coil of their 5-ton packaged air conditioner.

The coil bends, for instance, greatly simplify design. They're easy to form, offer less friction than fittings and cost less to make than a 3- or 4-fitting assembly. That goes for the finned coils, too. They're made by simply spiral-winding $\frac{7}{16}$" x .008" copper strip around the copper tube and then tinning the whole assembly.

And then, of course, there's nothing like copper's efficiency for thermal conductivity, nor its suitability for carrying hydrocarbon refrigerants. That's why you should ask for ANACONDA Copper Tubes and other ANACONDA Refrigeration Products by name. The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass, Ltd., New Toronto, Ont.

5190

**OTHER ANACONDA PRODUCTS FOR THE REFRIGERATION INDUSTRY**

*Restrictor Tube*
*Bourdon Tube*
*Thermal Expansion Bulbs*
*Formed Tube Parts*
*Hard Copper Tube cut to length*
*Copper Water Tube in coils or straight lengths*
*Fittings*
*Vibration Eliminators*
*Flexible Metal Refrigeration Conduit*

for consistent uniformity—ask for

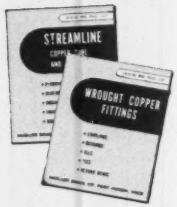
ANACONDA®

**REFRIGERATION PRODUCTS**

# Streamline®

## SOLDER TYPE GATE VALVES

**for dependable, long lasting service**




See your jobber for further information or write for catalogs S-351 and W-251 describing our complete line of STREAMLINE wrought copper and cast bronze fittings.

The new Streamline solder-type gate valve is built for durable operation in the 125# steam working pressure class of general service.

Its engineering design was perfected after many months of testing. Careful machining of seat and wedge disc gives positive shut-off with light pressure. Special lug design eliminates the possibility of installing disc backwards. And, non-rising stem allows installation in minimum amount of space.

The Streamline gate valve, which is furnished in a complete range of sizes from ½" nominal through 2" nominal, is an extremely rugged, seep-proof unit that will withstand the most severe usage and yet consistently give positive shut-off. Get the full facts today.

Streamline fittings are available in a complete range of standard sizes.

71

STREAMLINE PRODUCTS

**MUELLER BRASS CO.** PORT HURON 1, MICHIGAN

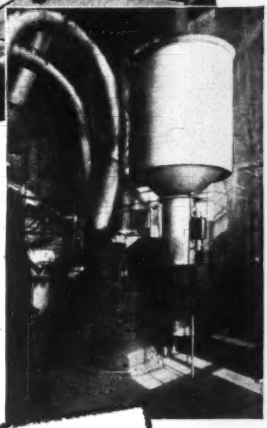
# "How we save $20,000 a year—USING COAL INSTEAD OF OIL"

Louis G. Notte,
Chief Power Engineer,
Little Falls Laundry,
Little Falls, N. J.

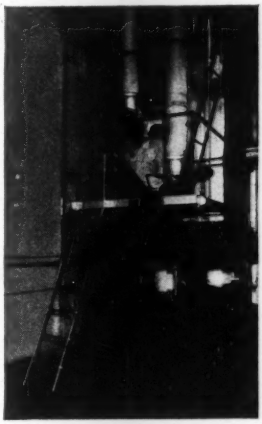
**(ACTUAL CASE HISTORY OF THE LITTLE FALLS LAUNDRY, LITTLE FALLS, N. J.)**

**"Our laundry is one of the largest in the country," says Chief Power Plant Engineer Notte, "and, we think, one of the most progressive. Our company insists on superior performance at lowest possible cost all along the line. That's exactly why we depend on coal-fired equipment. From coal we get the daily amount of BTU's we need at a cost of $200—to get the same BTU's from oil would cost $280. We can change to oil on less than a day's notice—but so far we've *never* done it. Coal does a great job—cheaper."**

To this plant in Little Falls 500 employees come to take care of the laundry for an estimated 100,000 people. And from this plant 100 trucks travel to customers across a 5,000 square-mile area! The laundry depends on coal to provide all electric power and lights—heat for all buildings—steam for hydraulically-operated machines—steam for pressers and dryers.



◀ The pulverizer from which coal is blown into the boiler. Before this operation, the laundry employs a conveyor belt to feed a precrusher. From there, conveyors carry the coal to the 100-ton hopper which feeds the pulverizer. *Modern coal devices slash labor costs—make coal's basic economy even greater.*



A section of the modern coal-fired boiler. With ▶ equipment like this it's possible to add 10% to 40% to the power derived from the same amount of coal in years past—to bring over-all boiler efficiency to 85% or more.

**If you're running your own steam plant, here are a few down-to-earth facts you don't want to miss!**

**COAL** in most places, is today's most economical fuel.

**COAL** resources in America are adequate for all needs—for hundreds of years to come.

**COAL** production in the U. S. A. is highly mechanized and by far the most efficient in the world.

**COAL** prices will therefore remain the most stable of all fuels.

**COAL** is the safest fuel to store and use.

**COAL** is the fuel that American industry can count on more and more—for with modern combustion-and-handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● Plants that use coal are in an enviable position—at the present *and* for the future. *For they are more certain than the users of other fuels of a dependable fuel supply—at stable prices.* The reasons are compelling. Of America's total fuel reserves, 92% is coal: Even today, oil is *imported* while this country can and does *export* coal. In addition—this country's mines are the most highly mechanized and efficient in the world.

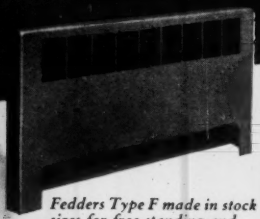
To get *all* the great economy that coal is capable of delivering—to find out how much more efficient and dependable a job coal and the very latest coal-fired equipment can do—call in a competent consulting engineer. He'll recommend the right equipment for your specific needs. Then you'll see exactly why coal *on a performance basis, on a dollars-and-cents basis . . .* is your best fuel buy, by far!

**BITUMINOUS COAL INSTITUTE**
**A Department of National Coal Association, Washington, D. C.**

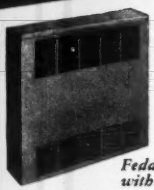
*FOR HIGH EFFICIENCY FOR LOW COST*

# *YOU CAN COUNT ON COAL!*

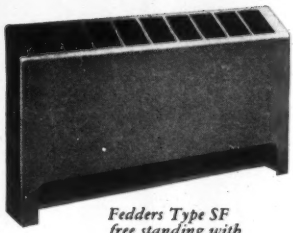
# fedders OFFERS AMERICA'S



*Fedders Type F made in stock sizes for free standing and semi-recessed installations. Also Type FO.*

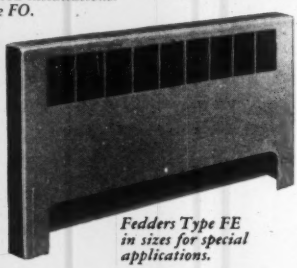


*Fedders Type FB with base grille.*

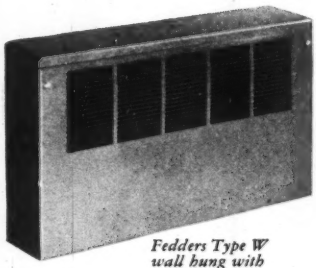


*Fedders Type SF free standing with sloping top.*

*Fedders Type SFB free standing with sloping top and base grille.*

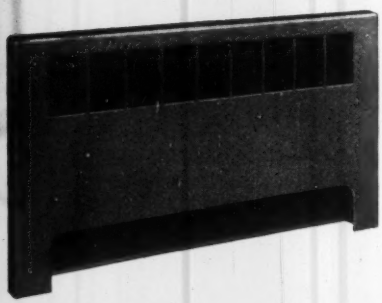


*Fedders Type FE in sizes for special applications.*



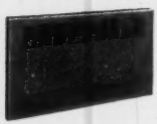
*Fedders Type W wall hung with flat top.*

*Fedders Type S wall hung with sloping top.*

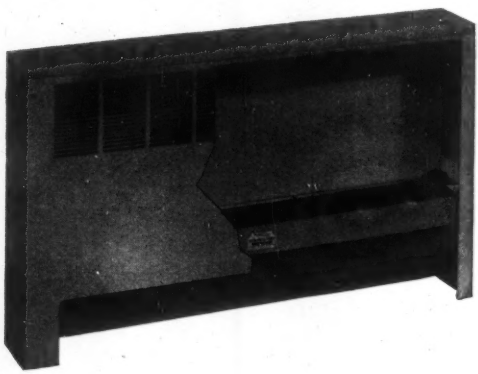


*Fedders Type R semi-recessed with overlap front.*

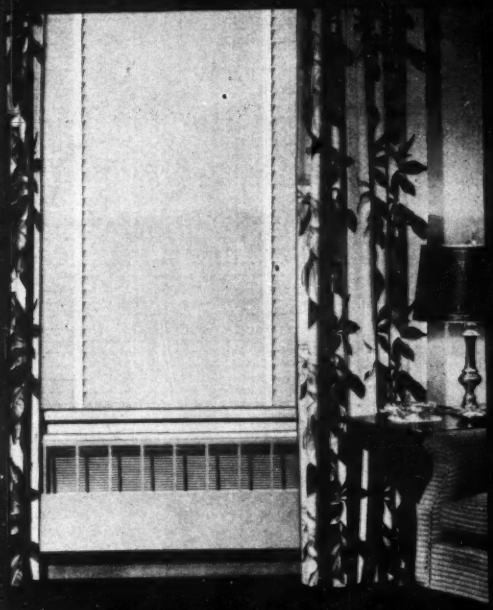
Cutaway view showing location of Fedders finned heating element in Convector cabinet. Note convenient arrangement for piping connections. Edges of cabinet are rounded for handsome styling.



*Fedders Type RB semi-recessed with overlap front and base grille.*



# QUALITY LINE OF



FEDDERS-QUIGAN CORPORATION, 57 TONAWANDA STREET, BUFFALO 7, N. Y.

Two Honeywell Weatherstats mounted outdoors, high above the street, are the Minnesota Building's keys to comfort and remarkable fuel saving.

# How Honeywell Customized Temperature Control Has Cut Fuel Bill 26% Over 15-Year Period in Minnesota Office Building

*Specially designed system paid for itself in 3 years—while furnishing tenants greatly improved comfort.*

The Minnesota Building, located in downtown St. Paul, is a typical mid-twentieth century American office building, and just about the most comfortable big building in town—all winter long.

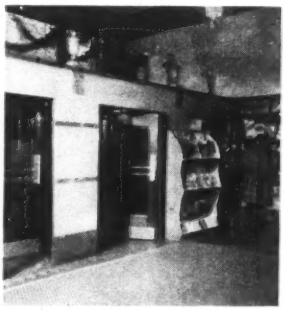
And providing every tenant with comfortable, even warmth—no matter how changeable the weather—is a Honeywell Customized Temperature Control System, installed fifteen years ago as a modernization project.

At that time Clapp-Thomssen Co., building managers, decided they'd go all-out to give tenants the finest comfort possible—and save fuel at the same time—by installing Honeywell Customized Temperature Control.

The customized system they had installed took the form of a Honeywell Weatherstat Zone Control System. And not only did this control system give the kind of comfort they expected—it made possible fuel savings that paid for the entire installation within three years!

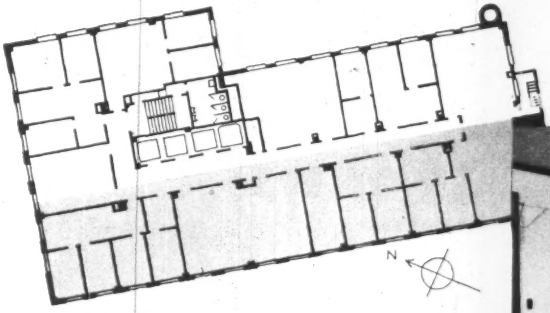
And since that time fuel savings have continued to average 26% a year.

Important to both comfort and fuel saving was the fact that Honeywell Customized Temperature Control compensated for exposure, use and occupancy differences. *How* it did is explained in the individual picture captions, and by the floor plan.



Special lobby temperature requirements are met by a separate thermostat system, and a unit heater. By making the lobby a special heating zone, cold air entering through doorways is compensated for easily by Honeywell Customized Temperature Control. Yet, visitors in winter street garb never become uncomfortably warm—and considerable amounts of heat and costly fuel are saved.

Ground floor locations that have less heat loss and generally higher temperature requirements than the lobby include the savings and loan office, shown at right, as well as shops, a cafeteria, and a blueprint company. All of these firms are located in a single heating zone. The thermostat for this zone is in the savings and loan office.



This view of a typical office shows two heating zones. The camera was set up in the northeast heating zone, while the portion of the office in view and around the corner is located in the southwest heating zone, shown in the shaded area on the floor plan. Both zones are controlled by Weatherstats mounted on the *outside* of the building. These truly remarkable Honeywell controls anticipate and compensate for changed heating requirements according to weather. In addition, separate thermostats *inside* give added control.

***Office Floors Controlled By Weatherstat***

The heating zones shown above—set up according to exposure, occupancy and construction—each have a separate Honeywell Weatherstat mounted outside the building. The Weatherstats—actual miniature zones in themselves—call for heat not only in direct relation to outside temperature, as do ordinary outdoor controls, but in relation to *wind and sun conditions as well!*

This type of control, together with indoor thermostats for each zone, means all tenants enjoy constant, comfortable temperatures. And because Weatherstat Zone Control eliminates over-heating, you get fuel savings like these enjoyed by the management of the Minnesota Building.

## *For Comfortable, Even Warmth in New or Existing Public Buildings, Specify Honeywell Customized Temperature Control*

Whether it's a store, office, school, garage—or any size public building—new or existing—there's a Honeywell Customized Temperature Control System to meet your clients' heating and ventilating problems.

Once equipped with a Honeywell Customized Temperature Control System, they'll have the newest, finest equipment available. They'll also have the right kind of controls to keep their employees, customers and tenants comfortable—and they'll save fuel besides.

For full facts on Honeywell Customized Temperature Control, call your local Honeywell office. There are 91 across the nation. Learn how these remarkable systems can help your clients and your business. Or mail the coupon today.

***"No more complaints—even in the most changeable weather," says building manager William D. Clapp.***

"Before we had Honeywell Customized Temperature Control installed, you never knew how many complaints you'd get on a cold day. Now if we get even one it's exceptional. And the 26% annual fuel savings have paid for the installation of the controls many times over."

MINNEAPOLIS-HONEYWELL
Dept. HA-2-44
Minneapolis 8, Minn.

Gentlemen: I'm interested in learning more about your Customized Temperature Control Systems for public buildings.

*Name* .....

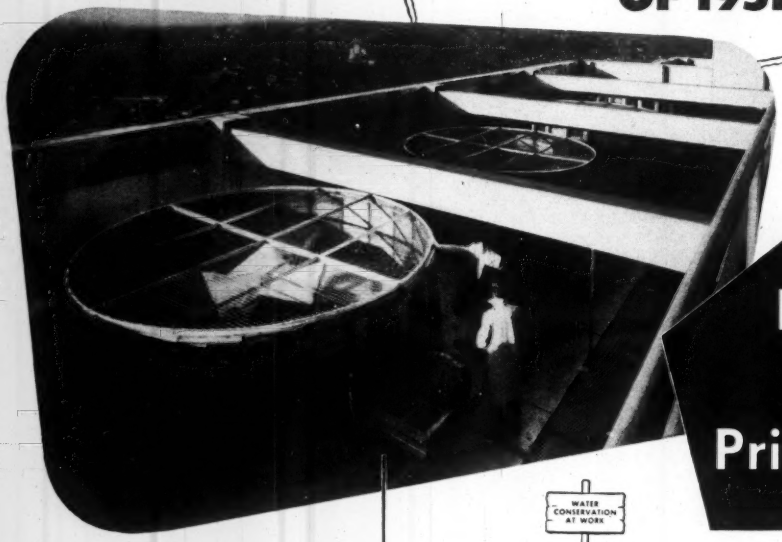
*Firm Name* .....

*Address* .....

*City* ..... *Zone* ..... *State* .....

MINNEAPOLIS
**Honeywell**
First in Controls

# HIGHEST* COMFORT AIR CONDITIONING TOWER OF 1951



**Built by Pritchard**

WATER CONSERVATION AT WORK

**Architect and Engineer:**
Harrison and Abramovitz, New York City

**Prime Contractor:**
Turner Construction Co., New York City

**Mechanical Engineers:**
Meyer, Strong and Jones, New York City

**Piping Contractor:**
Dravo Corp., Pittsburgh, Pa.

*Cooling Tower:*
*Equipment Division,*
*J. F. Pritchard & Co., Kansas City, Mo.*

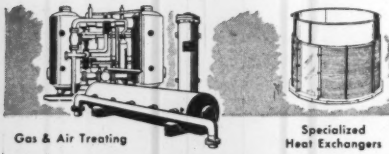
**Design Conditions:**
Capacity—7,648 gpm.
10° F. Cooling Range.
78° F. Wet Bulb Temperature.

*Above Grade

Located atop the new 525 William Penn Place Building (U. S. Steel-Mellon Bank) in Pittsburgh, Pa., is the highest* comfort air conditioning tower in the world. Built by Pritchard, this tower is one of the foremost engineering achievements in the comfort air conditioning field in 1951. This tower is the critical "heart" of the system it serves and it must provide a *lifetime* of unfailing, reliable service. Some of the major considerations thoroughly engineered for specific functions were:

Sound Control • Fog Dissipation • Drift Elimination
Algae Control • Thermal Capacity
Mechanical Reliability • Architectural Appearance
Operating Flexibility • Maintenance Facility • Personnel Safety
Insurability • Fire Hazards • Material Compatibility
Structural Stability • Building Code Conformance

And these problems were *all* resolved to the satisfaction of all concerned. This sky-high tower is proof of Pritchard's ability to coordinate architectural treatment, mechanical equipment, engineering "know-how" and modern construction methods into an outstanding cooling tower installation. Whatever *your* cooling tower problem, it will pay you to call Pritchard *first* and gain the benefit of Pritchard's experience. Your specific inquiry is invited.



Gas & Air Treating

Specialized Heat Exchangers

Cooling Towers

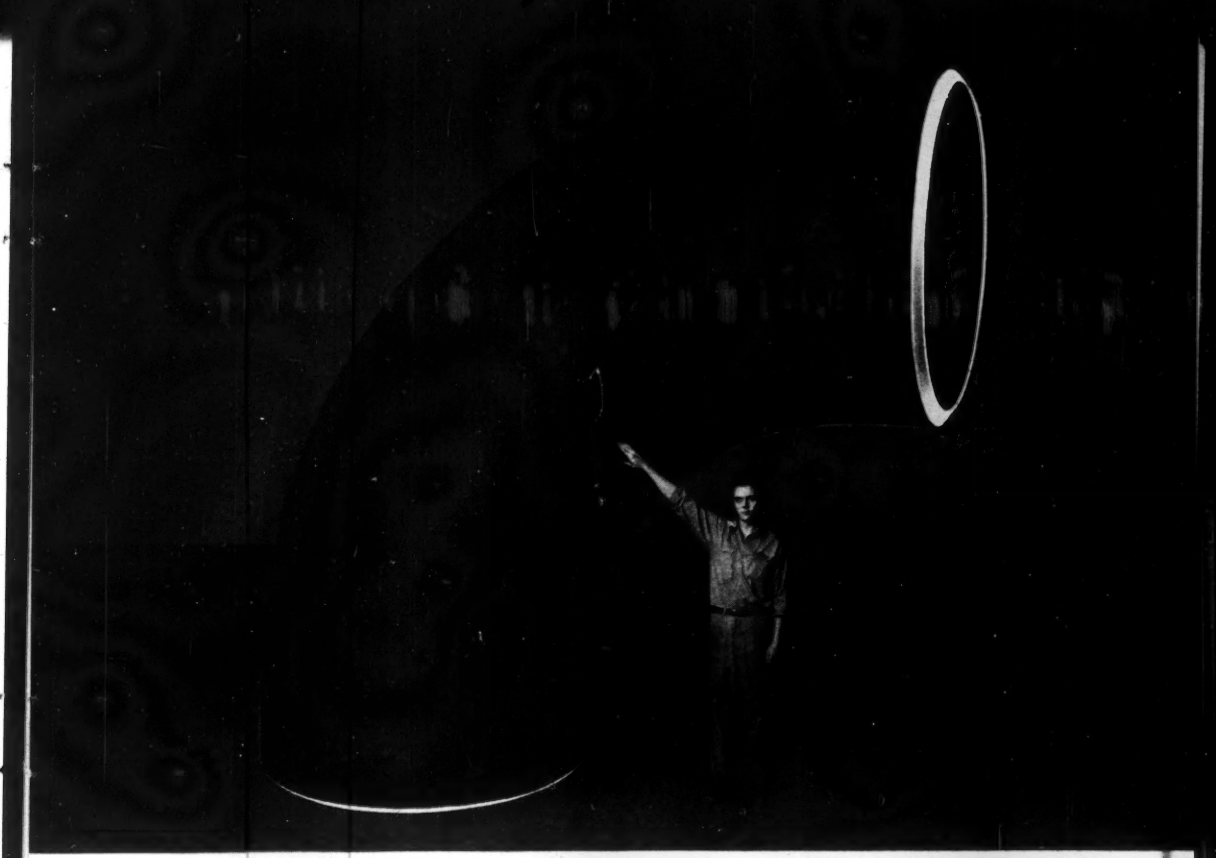
Producers of QUALITY Specialized Process EQUIPMENT

**J. F. Pritchard & Co.**

**EQUIPMENT DIVISION**

Dept. No. 252 — 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast



# We Haven't Made Them This Big... *YET,*

**but this photographic fantasy is simply to remind you that we do manufacture the most varied line of welding elbows on the market.**

**MIDWEST**
**PIPING & SUPPLY CO., Inc.**

**Main Office: 1450 South Second Street, St. Louis 4, Mo.**
**Plants: St. Louis, Passaic, Los Angeles and Boston**
**Sales Offices: New York 7—30 Church St. • Chicago 3—79 West Monroe St.**
**Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.**
**Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.**
***STOCKING DISTRIBUTORS IN PRINCIPAL CITIES***

**MIDWEST "LONG TANGENT"**

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

**ASA STANDARD**

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 26".

**SHORT RADIUS**

Recommended where space limitations do not permit use of "Long Tangent" or ASA Elbows. Sizes to 30".

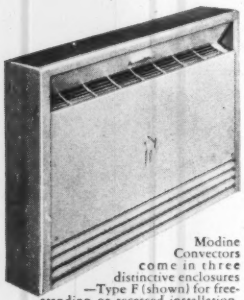
**MIDWEST REDUCING**

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

**Cleveland's Shaker Towers chooses MODINE**

780 Modine Convectors provide individual room comfort for 92 suites. Architect: Joseph Ceruti. General Contractor: Roediger Construction Co. Heating Contractor: Spohn Heating & Ventilating Co.

# *America's finest buildings use America's finest convectors*

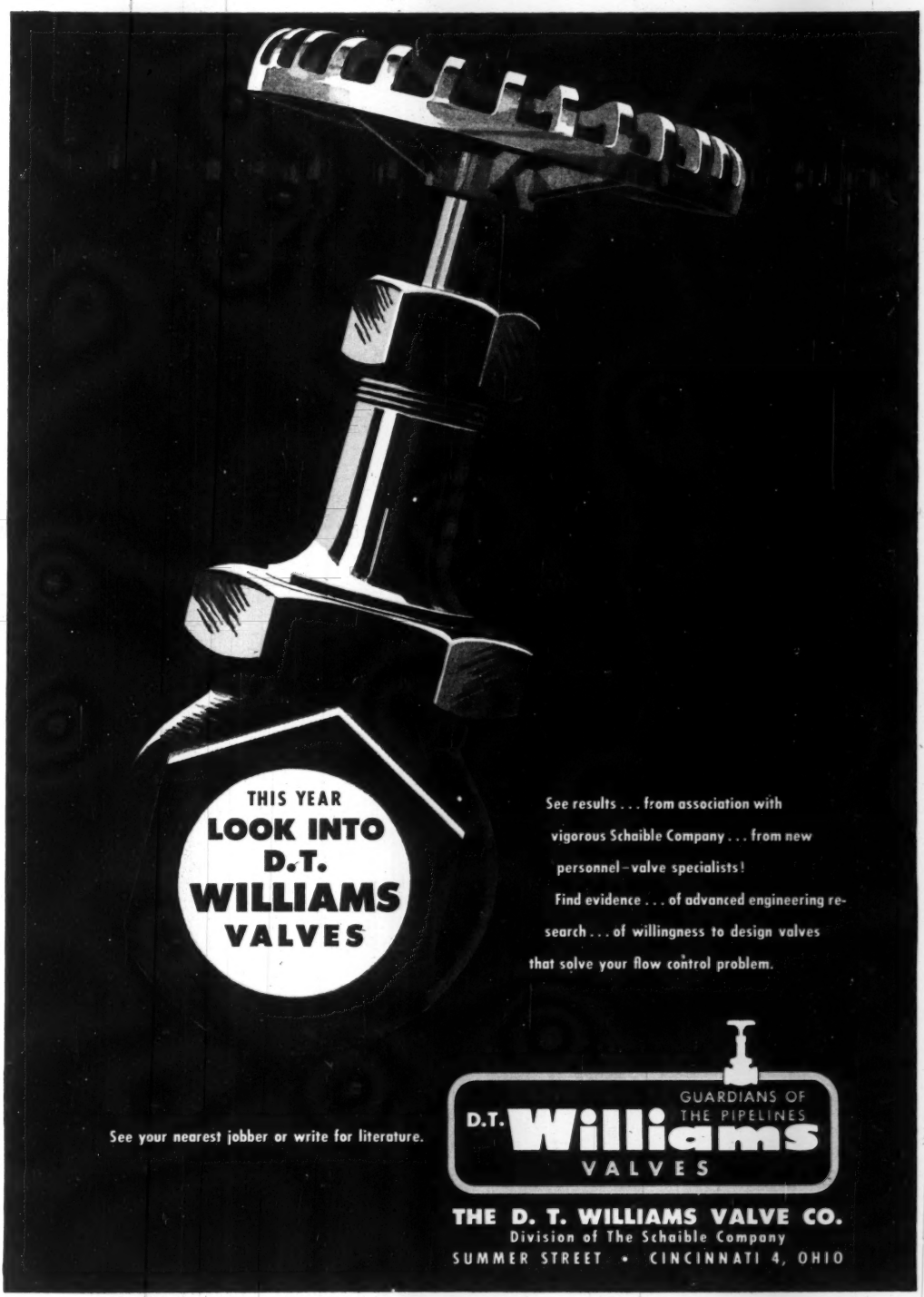


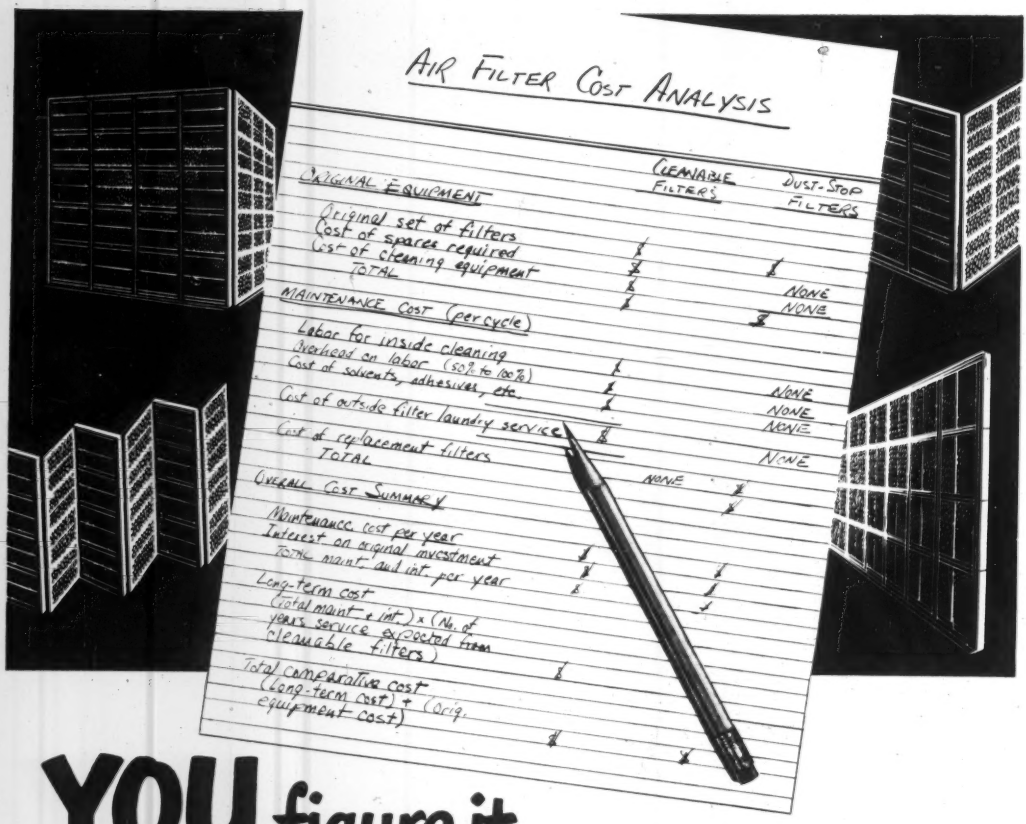
Modine Convectors come in three distinctive enclosures —Type F (shown) for free-standing or recessed installation, Types W and S for wall-hanging.

Today, superior heating performance must be teamed with subtle styling and long-life construction. On all counts, Modine Convectors meet the most exacting professional standards. That's why more and more Modine Convectors are being specified by leading architects and engineers. For full information on heating at its finest, call your Modine representative. You'll find him listed in your classified phone book. Or write Modine Mfg. Co., 1509 DeKoven Avenue, Racine, Wisconsin.

**Modine CONVECTORS**

R-1134


THIS YEAR
LOOK INTO
D.T.
WILLIAMS
VALVES
See results . . . from association with vigorous Schaible Company . . . from new personnel–valve specialists!
Find evidence . . . of advanced engineering research . . . of willingness to design valves that solve your flow control problem.
See your nearest jobber or write for literature.
GUARDIANS OF THE PIPELINES
D.T. Williams
VALVES
THE D. T. WILLIAMS VALVE CO.
Division of The Schaible Company
SUMMER STREET • CINCINNATI 4, OHIO



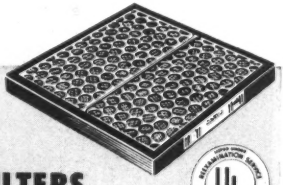

# YOU figure it... (4 TO 1, WE'LL SAVE YOU MONEY)

Do you really know which costs you less—cleanable air filters or Dust-Stop replacement-type filters? It's easy to figure out, using the method shown above and *your own cost figures.* Chances are about 4 to 1 that you'll save with new Fiberglas Dust-Stop* Air Filters.

You see, while rising labor costs have made filter cleaning more expensive, mass production has lowered the cost of Dust-Stop Filters. In fact, on the basis of one 40c cleaning every 90 days, cleanable filters would have to last up to 14 years to match the cost of Dust-Stop Filters replaced at the same intervals.

Owens-Corning Fiberglas Corporation, Dept. 40-B, Toledo 1, Ohio.

The "Comparative Study of Air Filtering Costs" contains facts, figures, and charts important to anyone interested in air conditioning. A copy free on request. Write today.



OWENS-CORNING FIBERGLAS

DUST STOP* AIR FILTERS

*T. M. REG. U. S. PAT. OFF.

## FIBERGLAS INSULATION FOR AIR DUCTS

Ageless, light in weight, firesafe, moisture resistant, Fiberglas Duct Insulations can be easily applied . . . have very high acoustical value . . . won't erode at 6,000 fpm . . . cost less than other insulations approaching them in thermal efficiency. Write for details.

*DUST-STOP is the trade-mark of Owens-Corning Fiberglas Corporation for impingement-type air filters made of glass fibers. FIBERGLAS is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with fibers of glass.

# AUTOMOBILES

*dramatize the role of* COPPER

Cruising down a modern highway in our new 1952 automobile gives us little cause to remember that COPPER is serving us faithfully in at least 45 parts of our present-day car. Copper aided in the development of the modern automobile from a mechanized buggy to the sleek mechanical perfection we drive today. So much so, that today this nation owns 45-million vehicles, and 25-million cars will take vacationists 150-billion miles of travel this year alone, barring wartimes.

Copper and copper base alloys serve in many of the most vital parts of your automobile including engine bearings, bushings, ignition system, cooling system . . . even underlying the chrome plating.

Important in this national application of copper and in every use to which copper is applied today . . . is HUSSEY COPPER . . . an all-American product since 1848.

## HUSSEY COPPER *and Brass*

**C. G. HUSSEY & COMPANY**
**(Division of Copper Range Co.)**
**ROLLING MILLS AND GENERAL OFFICES**
**PITTSBURGH 19, PA.**

*7 Convenient Warehouses to serve you:*

PITTSBURGH (19)
2850 Second Avenue

CLEVELAND (14)
5318 St. Clair Avenue

NEW YORK (13)
140 Sixth Avenue

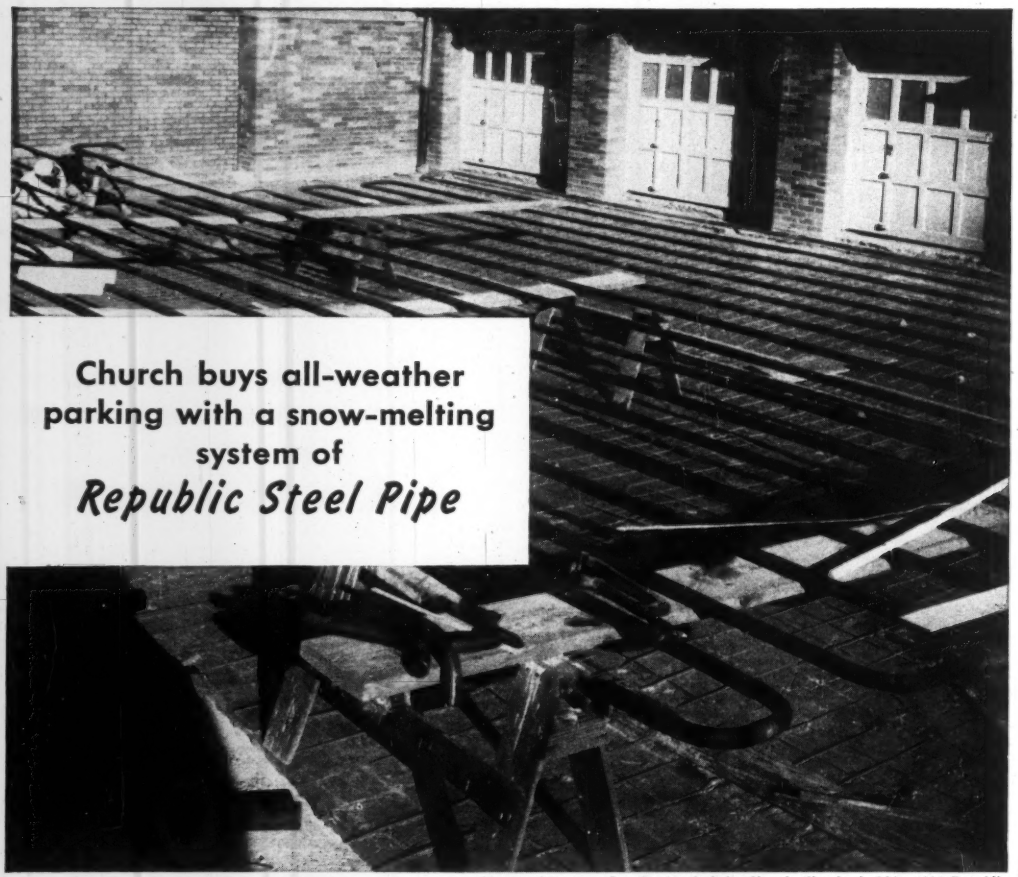
HUSSEY

CHICAGO (18)
3900 N. Elston Avenue

ST. LOUIS (3)
1620 Delmar Boulevard

PHILADELPHIA (30)
1632 Fairmount Avenue

CINCINNATI (2)
424 Commercial Square



## Church buys all-weather parking with a snow-melting system of *Republic Steel Pipe*

*New parking area, St. Aloysius Catholic Church, Cleveland, Ohio. 1¼" Republic Steel Pipe installed by Sweeney and Wise Company, Cleveland, heating contractors.*

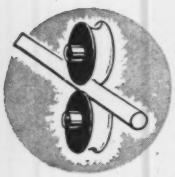
Like doctors, clergymen are called upon to answer many an emergency call. And, snow melting systems using Republic Steel Pipe are good assurance that blustery winter weather won't needlessly delay these errands of mercy.

As you know, for many years *steel pipe* has been standard for closed hot water heating systems. It has done that job well, giving long, trouble-free service. Its record *proves* you need nothing more costly than Republic Steel Pipe for today's . . . and tomorrow's . . . closed snow melting and radiant heating systems.

Made by Republic's *own* advanced Continuous Weld Process, it is highly ductile, easy to fabricate, especially suited to the close coiling and bending these systems require. It welds readily to tight, leak-proof joints.

It's a good idea to check with your Republic Pipe Jobber *now* about steel pipe for all the snow melting and radiant heating jobs you'll line up for later in the year.

**REPUBLIC STEEL CORPORATION**
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.



**REPUBLIC CONTINUOUS WELD PIPE**

Easy to bend, thread and close coil
Easy to weld by all methods
Uniformly ductile
Uniformly strong
Uniformly clean and scale-free
Uniform wall thickness, diameter, concentricity
Economical uniform lengths, extra long lengths
Expansion co-efficient same as concrete and plaster

Associated Architects: Mayer & Whittlesey • Skidmore, Owings and Merrill
Consulting Engineers: Jaros, Baum & Bolles
Heating Contractor: J. L. Murphy, Inc.

Owned and Managed by
NEW YORK LIFE INSURANCE COMPANY

# Manhattan House

—with 282 modern, carefully planned apartments occupies an entire block at 66th and 2nd Ave., New York City. Comfort and fuel savings obtained here, year after year, will yield a handsome return on the investment in POWERS control.

Type D Room Thermostat

# POWERS®

## ZONE TEMPERATURE CONTROL

***In this Outstanding Apartment Building***
***Assures Comfort, Dependability, Lowest Maintenance Cost***

Temperature of hot water supply to convectors in this modern building is controlled by a Powers **MASTROL** System.

**How It Operates**—A Powers Master Thermostat with its sensitive bulb in a special housing for sun-wind effect and outdoor temperature is located on outside wall of zone being controlled. It operates in conjunction with 4 Room Thermostats on the 4th, 9th, 14th and 19th floors of each zone through Averaging Relays to establish the control point for Series 100 Sub-Master Controllers. A manually operated switch on the main control panel is provided to raise or lower the control point when desired.

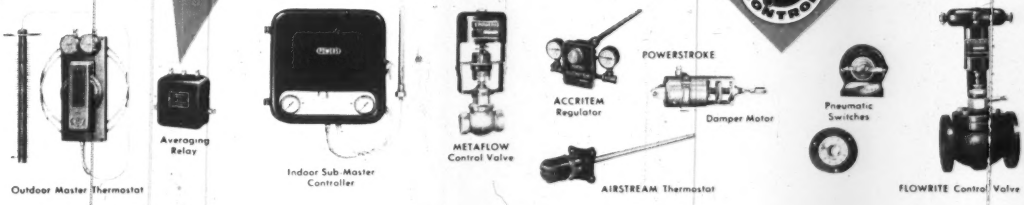
A program clock automatically reverts the controls to night operation during which period the outdoor Master Thermostat readjusts Series 100 Sub-Master Controller to a lower control point than used during day operation. Other types of Powers controls regulate various fans supplying heating and ventilating to other spaces in the building.

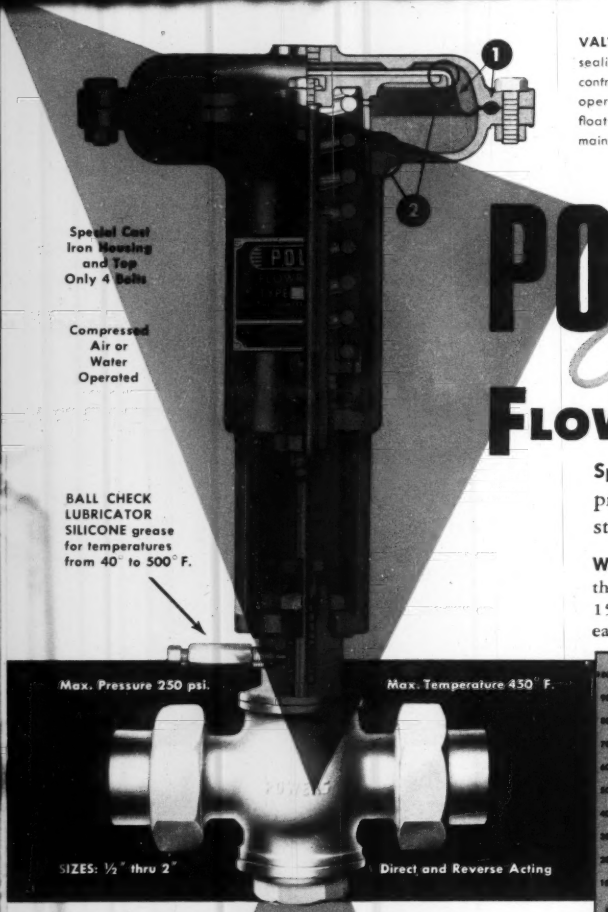
Experience gained by Powers in all types of prominent buildings will be helpful to you. When problems of temperature and humidity arise, contact our nearest office.

THE POWERS REGULATOR COMPANY, Skokie, Ill.

(8.77)

OVER SIXTY YEARS OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL — POWERS CONTROL — OFFICES IN OVER 50 CITIES



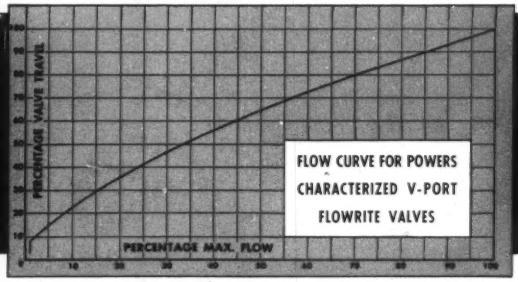

1
2
Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
BALL CHECK LUBRICATOR SILICONE grease for temperatures from 40° to 500° F.
Max. Pressure 250 psi.
Max. Temperature 450° F.
SIZES: ½" thru 2"
Direct and Reverse Acting

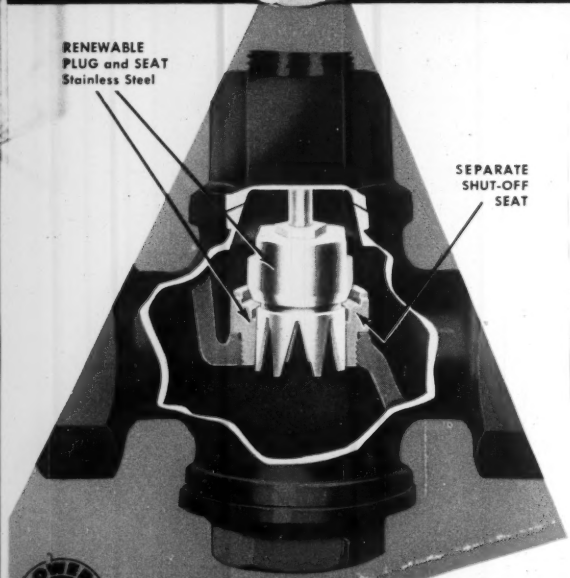
**VALVE TOP**—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

# POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—

**Special Flow Characteristics**—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

**Wide Variety of Valve Sizes**—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.




**Better Control—Less Maintenance**—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

*Low Hysteresis*—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

*Easy to Adjust*—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

*Easy to Install*—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

*Easy to Service*—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

***Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves***

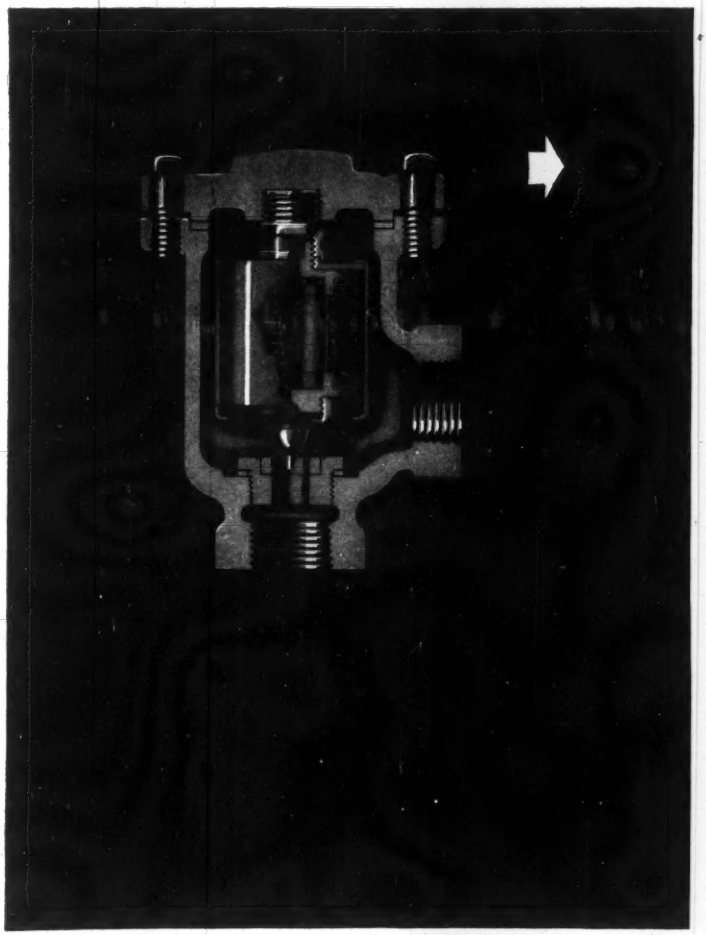
## THE POWERS REGULATOR CO.

SKOKIE, ILLINOIS • Offices in Over 50 Cities

Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th Street
Los Angeles 5, Cal., 1808 West 8th Street • Toronto, Ontario, 195 Spadina Ave.
Mexico, D. F., Apartado 63 Bis. • Honolulu 3, H. I., P. O. 2755—450 Piikoi at Kona

OVER 60 YEARS OF TEMPERATURE AND HUMIDITY CONTROL

(a70)



**STEAM FOR HEAT...**

If you use steam for room or space heating or for any process, such as cooking, drying, evaporating or baking, you must necessarily use Steam Traps.

**WHAT KIND OF STEAM TRAP?...**

Of the many different types offered which should you choose?

**SARCO MAKES 4 TYPES...**

and can fit the trap to the job. We can give you unbiased advice, based on 30 years' field experience.

**GIVE US FULL DETAILS...**

on your trapping problem and let us pick the best type of steam trap for you, and tell you why.

**A MOST VERSATILE TYPE...**

is the Sarco balanced pressure thermostatic trap illustrated here.

It is suitable for most process steam applications and has many outstanding advantages.

**AMONG SPECIAL FEATURES ARE:...**

Only one moving part—the Sarco flexible bellows made of phosphor bronze, stainless steel or monel metal for maximum resistance to fatigue and corrosion.

No seats to change when pressures change—No protection required against freezing. Unequalled capacity for air removal.

## Highest Discharge Capacity Per Dollar Cost

364

*Write for New Bulletin No. 250-9*

**SARCO COMPANY, INC.**

EMPIRE STATE BUILDING, NEW YORK 1, N. Y.
SARCO CANADA LTD., TORONTO 8, ONTARIO
REPRESENTED IN PRINCIPAL CITIES

# 4 EXTRA THREADS FOR LONGER LEAKTIGHT SERVICE

Leaky valves are bound to make home-owners unhappy. Why not protect your customers against this common source of trouble by insisting that Ohio Brass valves be installed on hot and cold water lines?

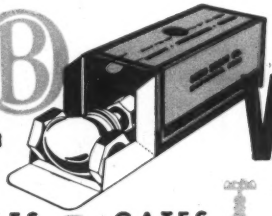
Four extra threads on the center-piece are one reason why O-B valves seldom leak around the stem. The extra take-up thus provided allows the packing nut to be pulled down as required. This keeps the long split-ring packing snugly compressed — a safe guard against stem leaks even after years of service.

On your next job be sure to specify Ohio Brass valves. Your local distributor carries them in a complete line of low pressure globes, gates, angles and checks. He will be glad to provide you with valves or any of your other plumbing and heating needs.

O-B No. 3
LINE GLOBE VALVE

With composition disc. Also available in angle type or with solder type ends ¼" to 2" in size.

4207-V



**Ohio Brass VALVES**

BRONZE GLOBES ANGLES GATES AND CHECKS

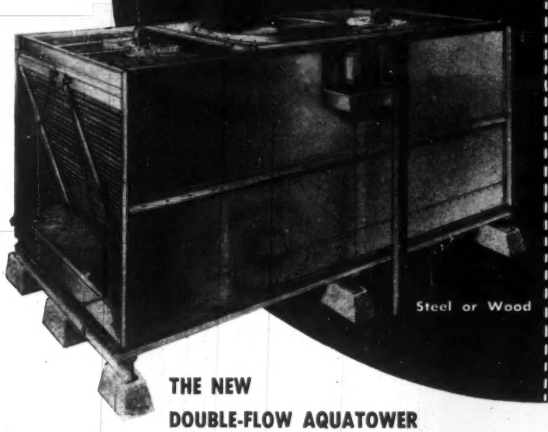
Up to 60 tons capacity

2 to 6 ton range

# 17 Sizes of

# MARLEY AQUATOWERS

## one for every water cooling job



Steel or Wood

**THE NEW DOUBLE-FLOW AQUATOWER**

**50 tons or more capacity**

The only *complete* line of "packaged" water cooling towers is the AQUATOWER line. In the 2 to 6 ton range, Marley offers Model 23 and 33 Aquatowers —small, compact units that soon pay for themselves in any service requiring as little as 6 gpm.

For intermediate capacities, you can choose from 8 standard size Aquatowers that fit any cooling requirement in that capacity range, indoors or out.

On jobs requiring 50 or more tons of refrigeration, Marley offers the NEW DOUBLE-FLOW AQUATOWER, the lowest silhouette, lowest pumping head tower. In this newest cooling tower, one fan utilizes air from two completely open sides, combining great efficiency and power economy.

Aquatowers in all sizes conform to building codes. Small and medium-sized units are shipped completely assembled and Double-Flow Aquatowers are prefabricated for ease of construction.

For complete information, call the Marley representative in your city or write for Bulletin AQ-52.

producers of

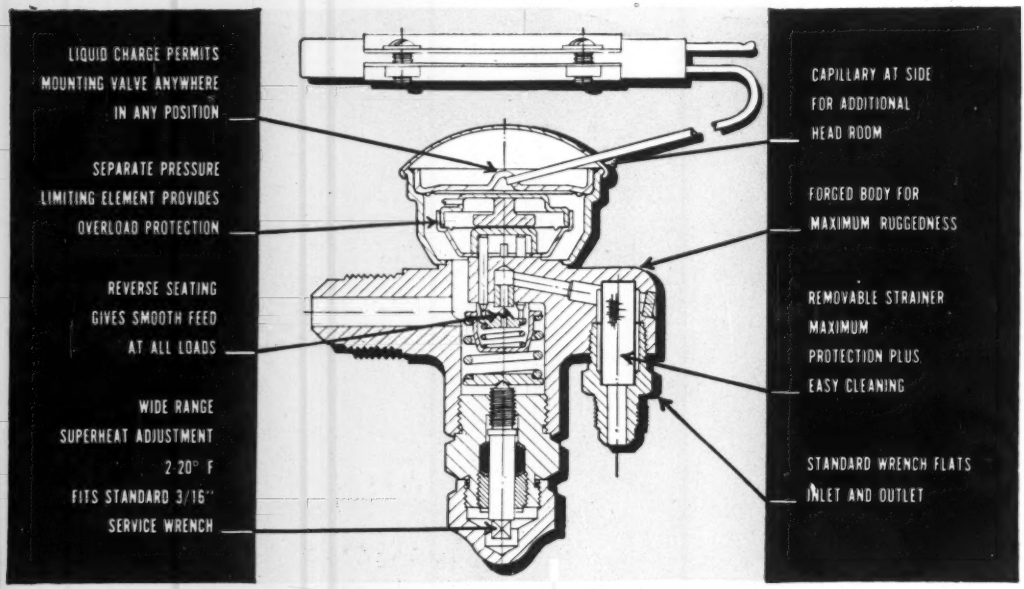
DOUBLE FLOW TOWERS
DRICOOLERS
AQUATOWERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES
VAIRFLO TOWERS
DOUBLE FLOW AQUATOWERS

MARLEY

**The Marley Company, Inc.**

WORLD'S LEADING PRODUCER OF WATER COOLING TOWERS

Kansas City 5, Missouri


LIQUID CHARGE PERMITS MOUNTING VALVE ANYWHERE IN ANY POSITION
SEPARATE PRESSURE LIMITING ELEMENT PROVIDES OVERLOAD PROTECTION
REVERSE SEATING GIVES SMOOTH FEED AT ALL LOADS
WIDE RANGE SUPERHEAT ADJUSTMENT 2-20° F FITS STANDARD 3/16" SERVICE WRENCH
CAPILLARY AT SIDE FOR ADDITIONAL HEAD ROOM
FORGED BODY FOR MAXIMUM RUGGEDNESS
REMOVABLE STRAINER MAXIMUM PROTECTION PLUS EASY CLEANING
STANDARD WRENCH FLATS INLET AND OUTLET

# ALCO

## THERMO VALVES TYPE 402

### FOR SMALL FIXTURES—ENGINEERED FOR SERVICE ENGINEERS

*pressure limiting for motor protection*

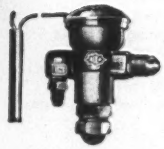
*dependable, tested performance*

*simple, compact construction*

*wide superheat adjustment*

*space-saving size*

402-4 for applications up to 1 ton F-12



402-2 for up to ½ ton F-12

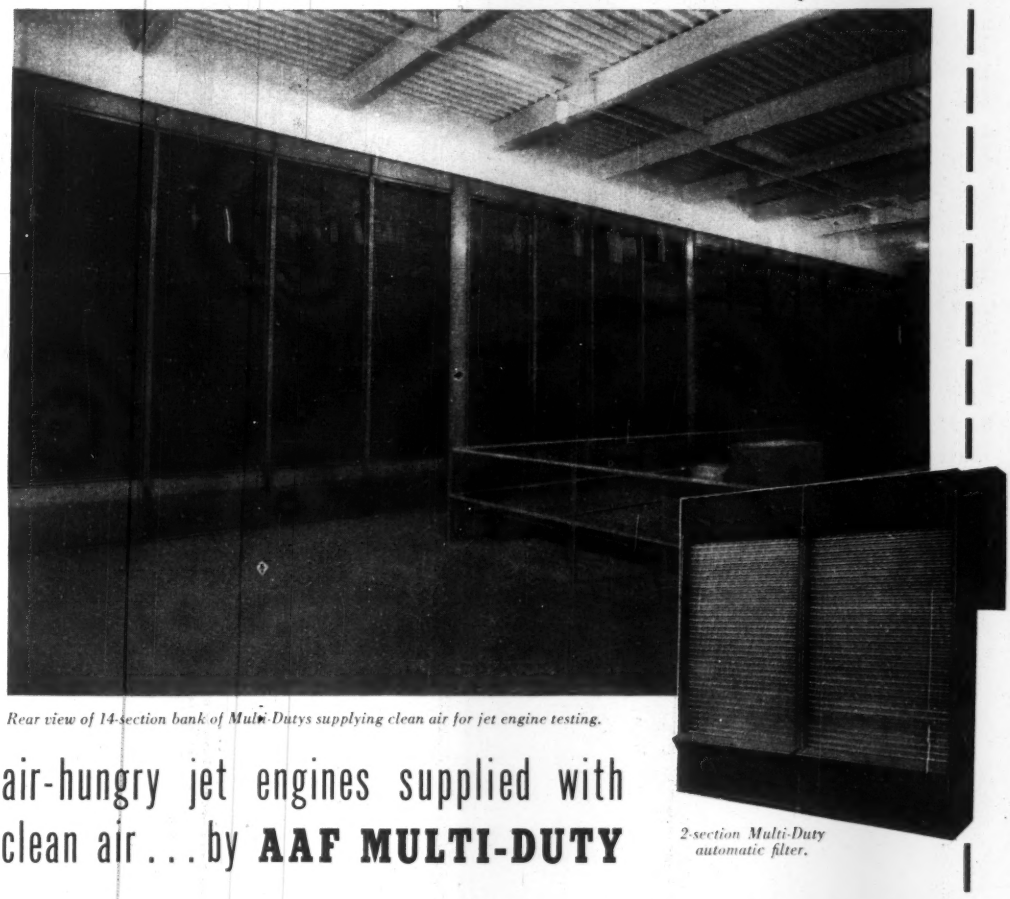
**ALCO VALVE CO.**

861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Evaporator Pressure Regulators; Solenoid Valves; Float Valves; Float Switches.

5012

# air as clean as you like it!



*Rear view of 14-section bank of Multi-Dutys supplying clean air for jet engine testing.*

## air-hungry jet engines supplied with clean air . . . by **AAF MULTI-DUTY**

*2-section Multi-Duty automatic filter.*

Jet engines consume enormous air volumes. In factory test areas this air must be *cleaned* to protect the impeller blades and air foil surfaces.

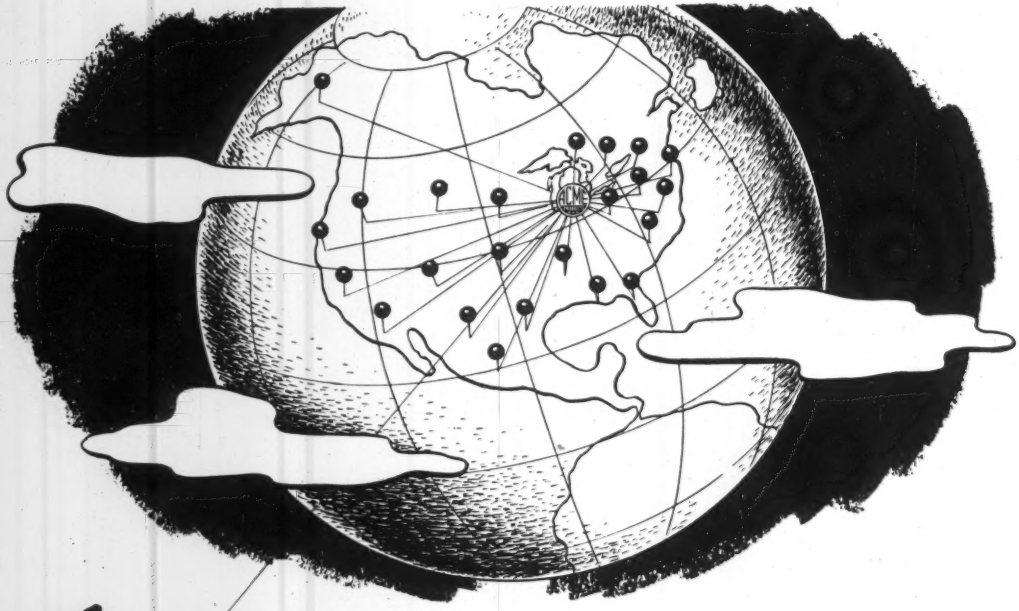
The 14-section installation of AAF Multi-Duty Air Filters shown here is one of a double bank supplying *clean air* to the test area of a large jet engine manufacturer. The Multi-Duty is an ideal filter for this type of application where constant clean air volume is required. It is fully automatic and self-cleaning . . . assuring maximum operating efficiency at all times without dependence upon the human element. Also the exclusive principle of overlapping panel construction in the Multi-Duty has never been surpassed as the most practical method of combining the function of self-cleaning with the operating cycle. This AAF filter is used in many industries and is available in any size or capacity.

You may not manufacture jet engines. However, if *clean air* for test operations or precision processes is one of your problems, call your nearby AAF representative. His solution will be based on AAF's complete line of engineered air filters and thirty years experience supplying *clean air* to industry. Write for Multi-Duty Engineering Bulletin No. 241A.

**American Air Filter**
COMPANY, INC.

373 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q. • Pacific Division Office, San Francisco, California

®AAF



# *Acme* products are in use *Everywhere*

In every major industrial center, you will not have far to go—to see a successful and efficient installation of *ACME* Refrigeration or Air Conditioning equipment. In offering practical solutions to temperature control problems, *ACME* Engineers have had an opportunity to study normal and abnormal temperatures, humidity and prevailing conditions. From this long experience *ACME* Engineers have developed a line of refrigeration and air conditioning components that meet practically every requirement of the Refrigeration and Air Conditioning Industry. Whatever your immediate problem may be, the chances are that the nearest *ACME* representative can show you an actual installation of *ACME* products which is successfully meeting requirements similar to yours. *ACME* Products have been tried and are in actual use in practically every climate under practically every possible condition. You can depend on this long established and time tested line of major refrigeration components to give you efficient, low cost, long lasting service.

## THE COMPLETE *Acme* LINE INCLUDES

**Freon Shell and Coil, Shell and Tube and Ammonia Condensers.**
***Dry-Ex Water Coolers**
***Hi-Peak Water Coolers**
**Heat Exchangers**
**Unit Coolers**
**Oil Separators**
**Convectors**
***Flow Cold Liquid Chillers**
**Evaporative Condensers**
**Cooling Towers**
**Liquid Receivers**
**Air Handling Units**

* TRADE MARK

*Free Consultation with ACME Engineers is yours for the asking.*
*Write ACME INDUSTRIES, INC., Dept. HP, Jackson, Michigan*

ACME PRODUCTS

**ACME INDUSTRIES, INC.,** JACKSON, MICHIGAN, U.S.A.
**Refrigeration and Air Conditioning Division**
*CONTINUOUSLY SERVING THE AIR CONDITIONING AND REFRIGERATION INDUSTRY SINCE 1919*

# SPANG CW

## keeps West Virginia's skaters on their toes

Figure skaters never worry about the weather in Huntington, West Virginia. In their new million dollar recreational center the ice stays hard and fast all during the season. And it's kept that way day after day by a refrigerant flowing through a welded web of Spang CW Steel Pipe under the entire skating area.

Wherever long time reliability is a must—whether in skating rinks or the largest commercial buildings—architects, contractors, owners consistently specify dependable Spang CW. They know from experience that the name Spang is a guarantee of year after year of maintenance-free service.

Quality-controlled from steel to finished form, Spang CW is always uniform in every dimension. Easy to cut, easy to weld, easy to bend, it's the *easy* way to reduce installation time and costs.

Specify Spang CW Steel Pipe by name—you'll find leading distributors in every section of the country.

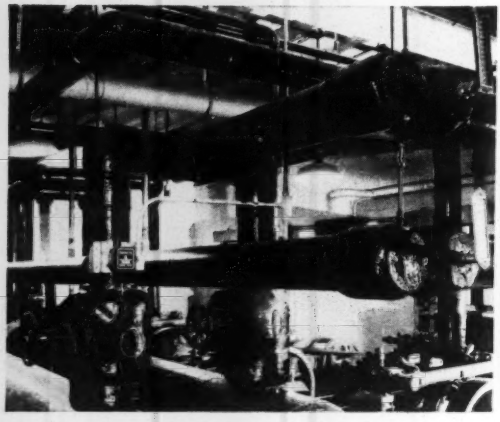
*Owners:* Cabell County Recreation Board *Architect:* Lewis E. Stettler
*Contractors:* Frick Company, Waynesboro, Pa.

SPANG

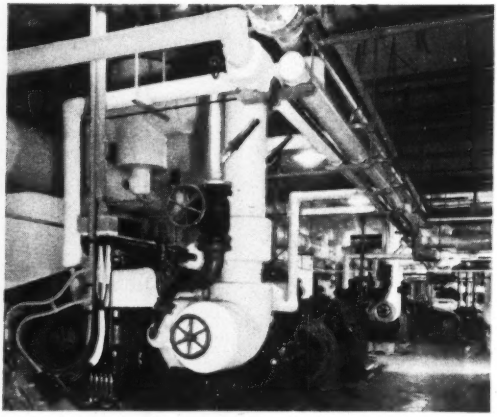
**SPANG-CHALFANT**

DIVISION OF THE NATIONAL SUPPLY COMPANY

General Sales Office: Grant Building, Pittsburgh 30, Pa. District Sales Offices: Atlanta, Boston, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis



Cold line painted with Cork Covering Paint has neat, shiny black finish.



Sewed canvas provides de luxe finish and can be painted any desired color.

# We have been asked . . .

"What's the best finish for cork insulated cold lines?"

A letter we recently received from a hotel engineer presented the following problem: "We are running some refrigeration lines in connection with the air conditioning of our dining rooms and wonder what would be the best finish for the cork covering on these lines."

Here's how we answered him: The proper finish for cork covering should be determined by two things—the conditions surrounding the lines and the desired appearance of the installation.

Where piping runs through dry rooms, the recommended finish for most installations is Armstrong's Cork Covering Paint. This brushed-on asphaltic paint provides a neat, shiny black finish for the line and also reinforces the vapor resistance of the factory-applied asphalt mastic finish on the cork covering.

For areas where a de luxe appearance is desired, the canvas finish is recommended. So that the finished job will be neat and smooth, a layer of rosin-sized paper is wrapped around the covering before 8-oz. canvas is neatly pasted or sewn in place. After the canvas is in place, it can be sized and then painted in any desired color.

Where piping runs through wet or humid atmospheres, refrigerated rooms, pipe shafts, or outdoors, roofing paper should be wired on straight pipe runs and painted with Armstrong's Cork Covering Paint. On fitting covers, Armstrong's Insulmastic, a weatherproof asphaltic compound, should be troweled on over hexagonal wire mesh.

In addition to these finishes, Armstrong can furnish special solvent-proof and fire-resistant finishes for cork pipe covering.

When you have any question about the selection or finishing of cold line insulation, consult the Armstrong engineer. He can furnish sound, practical advice on any insulation problem. The complete contracting organization he represents is equipped to handle any insulation job—offering qualified engineering aid, top-grade materials, and skilled application.

**SEND US YOUR QUESTIONS:** If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a prompt and practical answer. Just address a letter or post card to Armstrong Cork Company, 4402 Maple Street, Lancaster, Pennsylvania.

# ARMSTRONG'S INDUSTRIAL INSULATIONS

**MATERIALS - INSTALLATION**

**FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.**

# THE EDITOR'S PAGES

## CONVECTOR MAKERS REVIEW YEAR'S HIGHLIGHTS

MAJOR MANUFACTURERS OF convector radiators are now rating their convectors according to Commercial Standard CS 140-47, according to Walter G. Schlichting, president of the Convector Manufacturers Association. This code was developed cooperatively by the trade and the National Bureau of Standards.

Reviewing other highlights of the work of the CMA during 1951, Mr. Schlichting pointed to substantial progress in the industry's research program and continued effectiveness of the national consumer education program. The research program at Cornell University, underwritten by the association, has produced information and important data on principles of effective heat for steam heated structures.

The broad consumer education program on convectors has been effective in supplying helpful information on the selection, use and performance of convectors in homes and institutional buildings, he said.

## STUDY REVISION OF CONDITIONER STANDARD

PROBABLY THE MOST controversial paper presented at the recent annual meeting of the American Society of Refrigerating Engineers, held in New Orleans, was the one on the construction, operation and test results of the calibrated room calorimeter, for testing room air conditioners.

This device, specified by ASRE standard 16-R adopted in December 1949, has been objected to by a number of manufacturers for various reasons. Consequently, the ASRE council decided to authorize the standards committee to review the standard for the possible purpose of revising it.

## POLLS EDITORS ON ENGINEERING ADVANCES

DEVELOPMENTS IN THE production and use of steel represent the most significant engineering advance of the past century, according to the majority opinion of editors of 32 leading trade journals and business publications. Electric power production and application were a close second.

The editors were polled by Dr. John R. Dunning, dean of engineering at Columbia University, on the eve of the "centennial of engineering", which will be observed in 1952. "What, in your opinion, has been the most significant development in your field of engineering in the past century?", was his question.

The editors who chose steel pointed to such achievements as the Bessemer convertor, the regenerative principle of steel making, the construction of high speed continuous mills for rolling steel strip and sheet, the skeleton frame-curtain wall concept of building, the development of a host of alloys, and the improvements in the quality of steel.

Other major developments mentioned by those who responded included air conditioning, and automatic central heating with oil and gas.

## LAUNCHES STUDY OF CLASSROOM HEATING

ALERT CLASSROOM performance needs schoolroom temperatures that are properly keyed to the children's activity, an educator reports.

According to R. H. Jacobs, director of marketing for the Minneapolis-Honeywell Regulator Co., this relationship was established in a series of studies into the effects of classroom heating conducted by Dr. Darell Boyd Harmon, former director of school health service for the Texas state department of health, who has been retained as school consultant to Honeywell.

The premise of Dr. Harmon's work, Mr. Jacobs says, is that the classroom should provide an environment in which the heat produced by a youngster's body will be absorbed at the proper rate to keep the body at its normal temperature. As the child's body is forced to make continual adjustments to improper schoolroom temperature conditions, this very protective action taxes the body's vitality and energies, and reduces the child's inclination to apply himself to his studies.

Current research being directed by Dr. Harmon is a continuation of extensive studies he has already made into other phases of classroom environment. For example, Dr. Harmon has conducted studies of more than 160,000 school children demonstrating effects of improper lighting, seating, decorating and arrangements in the classroom on the health, development and learning ability of school children.

## RESIDENTIAL COMMUNITY TO BE AIR CONDITIONED

THE "FIRST ALL-YEAR-ROUND air conditioned residential community in the east" is under construction in Heathcote Heights, New Rochelle, N. Y., according to the builders, the Heathcote Heights Building Corp.

Charles A. Newbergh, president, revealed that an order had been placed with Carrier Corp., through the Thermodyne Corp., New York distributors, for the delivery of 50 air conditioning units to be used in the residential community This is believed to be the first instance where an entire community has been planned for air conditioning in its original construction. Eventually, Heathcote Heights will have 75 homes, built to sell for $40,000 and up.

An air conditioned home is freed of window and layout problems due to ventilation and cooling requirements, according to the announcement. It is not necessary, for example, to provide at least two movable sash windows in every room

for cross ventilation. All windows are kept closed, providing comfortable, clean and quiet living throughout the year, regardless of outdoor weather, dust and street noises.

Since air is circulated at the desired temperatures throughout all living areas, windows can be grouped with complete freedom to take advantage of the best natural light and view, of solar heating, or of interior living arrangements.

"Halfway comfort measures" such as louvers, casement windows alongside picture windows, movable sash windows in every room, screens, storm windows, and attic fans can be eliminated along with the expense of providing them, and the building itself — freed from the cross ventilation problem — can be laid out on an economical square or rectangular floor plan, which gives more interior living space in proportion to expensive outside walls, the announcement continued.

## "EMPHASIZE BASIC SCIENCE IN SCHOOLS"

A PLEA THAT ALL engineering schools should devote themselves to ways of making substantial improvements in their courses of study was made by the committee on adequacy and standards of engineering education of the Engineers' Council for Professional Development, as a result of an extensive study made by this committee.

Chairman S. C. Hollister, Dean of Engineering, Cornell University, reporting for the committee, said that "it becomes clear that there is going to be a shortage of engineers for many years to come. At such a time, in the national interest, it is of paramount importance that the best possible education in engineering be provided by our schools. Each man is going to be called upon to cover a greater range than heretofore, if the engineering needs are to be met. Every school should devote itself to ways of substantial improvement of its program, to the end that its graduates will meet the responsibilities being placed upon them."

Tracing the history of engineering education, the committee pointed out that emphasis on engineering arts rather than engineering science, which "is all too prevalent in the engineering colleges," results in rapid obsolescence of the methods and information learned whereas education predicated on science and the "engineering approach," will sustain the engineer for his lifetime. Because educators should be preparing students for professional work that will reach a maximum culmination 20 or more years hence, courses least likely to obsolesce should be given. In this category the committee placed mathematics as the outstanding example.

### "QUOTE"

"World and economic conditions demand that product quality be kept at highest possible standards and that costs be kept at lowest possible minima. Industrial instruments are being called upon to become the hearts and brains of America's accelerated demand for new, better and more products. These are a few of the major reasons why industrial instrument makers can look forward to business increases that will tax the skill, imagination, engineering and productive ability of the industry." — HENRY F. DEVER, President, Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

## UNITS COMFORT-COOL A FACTORY

AIR CONDITIONING installed in factories is usually purchased to maintain controlled temperature and humidity conditions required for the manufacturing process. A recent installation by the Bell Refrigeration Corp., Cleveland, illustrates a "new trend" — air conditioning intended primarily for the comfort of factory employees — says the Typhoon Air Conditioning Co., Inc. The equipment, purchased by the Anderson Spring Co., manufacturers of steel springs, consists of two 20 ton packaged units installed directly in the conditioned area, and a 5 ton unit for the offices.

Anderson Spring's offices are cooled by tying a 5 ton unit on to the existing heating ducts, changing the distribution grilles, and making some modifications in the duct sizes to adapt the distribution system for cold air.

The original estimate for this installation came to nearly 50 tons, but by utilizing condenser waste water by spraying it on the flat roof, Bell engineers reduced the load to 40 tons. In addition, the condensate drain water is pumped to the roof by means of a small pump mounted on each 20 ton unit.

## AIR POLLUTION IS PLANT LOCATION FACTOR

PLANT LOCATION based on the weather has been advocated as a major step toward solving the problem of industrial air pollution. The cost of a study of the "air pollution potential" of a possible plant location represents but a tiny fraction of the total investment in the plant and can pay large dividends in good will, efficiency and even labor relations, Dr. Frederick G. Sawyer, administrator, air and water research, Stanford Research Institute, Stanford, Calif., declared at the 72nd annual meeting of the American Society of Mechanical Engineers, which was held in Atlantic City.

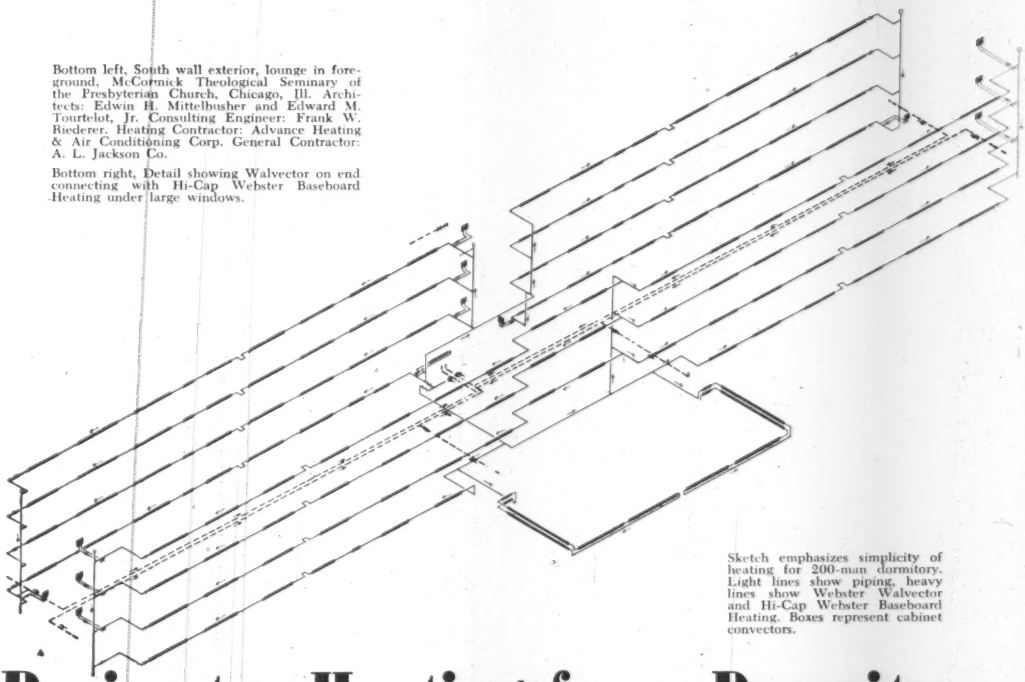
The time has come, Dr. Sawyer said, when in addition to the usual considerations — proximity to raw materials, cheap and usable water, transportation facilities, labor, etc. — the weather must also be considered as an important factor in plant location. He said this new factor will grow in importance proportionally to the inevitable increasing severity of air pollution control ordinances throughout the country. A company can design and build a plant which will not be an air pollution hazard if it is armed with weather data from which to evaluate possible plant sites, he said.

Dr. Sawyer said that research at Stanford Research Institute shows that the burning of 50,000 tons a day of fuels and rubbish is the principal cause of smog in Los Angeles county. He said that of the total combustion and evaporation products put into the air daily, about 40 percent come from industrial sources and 60 percent from activities of the general public, such as building heating and exhaust from the automotive engine, a major source of pollution.

Nevertheless, he said, the average citizen blames industry for most of the atmospheric pollution. Although only partly responsible, industry must demonstrate good faith, friendliness, community interest and public regard by taking the lead in cleaning up itself, he declared.

Bottom left, South wall exterior, lounge in foreground, McCormick Theological Seminary of the Presbyterian Church, Chicago, Ill. Architects: Edwin H. Mittelbusher and Edward M. Tourtelot, Jr. Consulting Engineer: Frank W. Riederer. Heating Contractor: Advance Heating & Air Conditioning Corp. General Contractor: A. L. Jackson Co.

Bottom right, Detail showing Walvector on end connecting with Hi-Cap Webster Baseboard Heating under large windows.



Sketch emphasizes simplicity of heating for 200-man dormitory. Light lines show piping, heavy lines show Webster Walvector and Hi-Cap Webster Baseboard Heating. Boxes represent cabinet convectors.

# Perimeter Heating for a Dormitory

True perimeter forced hot water Webster Heating was provided for the new dormitory building at McCormick Theological Seminary.

Continuous Heating Elements connected in series blanket the windows . . . spread the heat uniformly on every floor.

Consulting Engineer Frank W. Riederer says:

"The continuous radiation design contributed to economy of first cost. It eliminates exposed piping, leaves more usable room space, produces uniform heating.

"Steam from the Seminary's central heating plant is converted to hot water in a heat exchanger. In this design, the hot water system proved less expensive and more satisfactory than a system using steam."

Call the Authorized Webster Factory Representative or write us for his name.

Address Dept. HP-2

**WARREN WEBSTER & COMPANY**

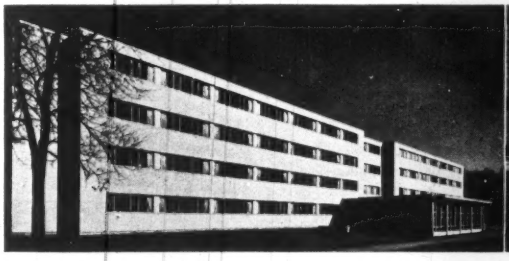
Camden 5, N.J. Representatives in Principal U.S. Cities

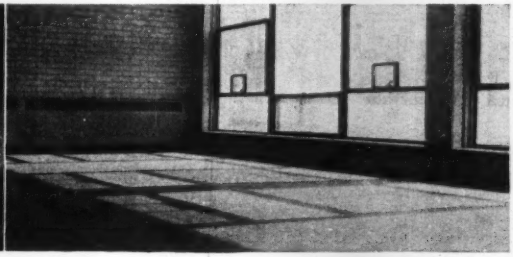
*In Canada, Darling Brothers, Limited, Montreal*

**Webster WALVECTOR**

REG. U. S. PAT. OFF.

**For Steam or Hot Water Heating**

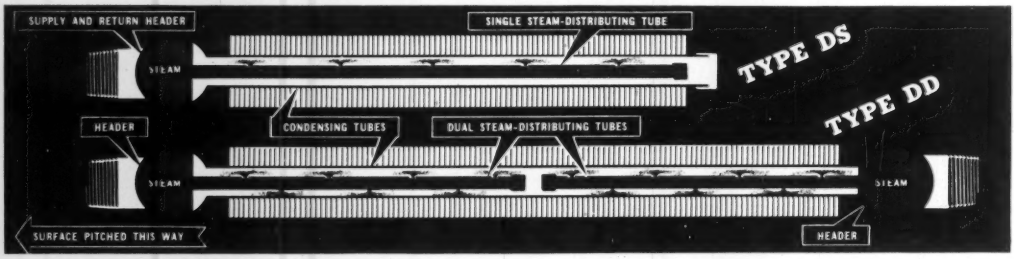




# NESBITT Positive Freeze Protection

## results from (1) Uniform Steam Distribution, and (2) Condensate always exposed to entering Steam

### NESBITT SERIES D SURFACE IS MADE IN TWO TYPES:




**TYPE DS SURFACE:** Single supply header; single steam-distributing tube inside each condensing tube, for normal heating and ventilating applications. For installations requiring more uniform discharge temperatures, Type DS Surface with DUAL steam-distributing tubes in finned lengths up to six feet.

**TYPE DD SURFACE:** Two supply headers (one at each end of the surface section); DUAL steam-distributing tubes inside each condensing tube; steam conducted from the header at each end toward center. Assures uniform discharge temperatures over finned lengths from 78" to ten feet.

How STIFF are the surface requirements in that low-pressure, valve-controlled job of yours? Must you have *strictly uniform discharge temperatures*, regardless of coil length? Then specify Nesbitt Series D Heating Surface with DUAL steam-distribution tubes. Or do you have *less exacting requirements*, but still need acceptable distribution, regardless of coil length? Then specify Nesbitt Series D Heating Surface with SINGLE steam-distributing tubes. All Nesbitt Series D heating coils are *freeze-proof* without the aid of pre-heaters because of the steam-distributing tube feature, developed by Nesbitt. Play safe: say *Nesbitt*.

**FREE:** Publication 247, Nesbitt Series D Heating Surface; Publication 248, Nesbitt Series H Surface, for Heating, Ventilating, Drying; Publication 246, Nesbitt Series W (Water) Surface, for Air Cooling, Dehumidifying, Heating.

OFFICES IN ALL PRINCIPAL CITIES—LIST UPON REQUEST

# "OPEN FOR DISCUSSION"

*We follow here each month the practice at engineering society meetings of providing an "open for discussion" period. You are invited to participate. Please address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2*

## COMPUTING THERMAL CONDUCTIVITY OF SOILS

ANDREW GEMANT'S article in the January HPAC on how to compute thermal soil conductivities, which presents equations for the calculation of thermal conductivities of soils containing mixtures of sand, clay and moisture, may prove to be of unusual value in the many fields where the flow of heat in soil presents a problem. The various experimental determinations of soil thermal characteristics have been valuable, but can never be as satisfactory as a method by which such values can be calculated. The agreement between the experimental and calculated values presented in this paper is very gratifying — especially since two separate sources of experimental data were used.

The original theory was ably described in *The Thermal Conductivity of Soils*, mentioned in the article as the first reference, but apparently the theory on the equations was given in the German paper, mentioned as the second reference. While this will be available at a future date, a presentation in the English language would make the method of much more value to the many who are vitally interested in this subject, and most of whom could not translate the basic article.—GEORGE S. SMITH, Professor of Electrical Engineering, University of Washington.

## METHODS OF RATING NOISE FROM FANS

A METHOD OF FAN NOISE rating must consider the following:

1) Annoyance as heard by the average person.

2) The attendant vibrations that can be transmitted to surrounding structures.

3) In military applications, the danger of noise being picked up by opposing forces.

4) A rating that cannot be used promiscuously.

A realization of the above conditions immediately precludes the use of the human ear as a measuring device, just as the use of the human eye for measuring light is precluded.

Where bids contain noise specifications, it has been the writer's policy to submit his interpretation of such specifications and obtain acquiescence before bidding. Noise specifications are a necessary adjunct to any bid and when based on a strong code reflect progress. Generally, the fan manufacturer will not accept orders if he is not sure of the specifications.

I think that R. A. Gerlitz — in his article, *Fan Noise Ratings "Should Depend on Human Element"*, in the December HPAC — is incorrect in comparing anvil noises with fan noises, as such an anvil noise can only be occasioned by a blade striking the fan race.

If such peak pressures as shown in his Fig. 1 did occur in fan work, then the fan would most certainly be rated at the peak pressures — which would show on the sound level meter.

In Fig. 2 of Mr. Gerlitz's article, the lower extremities of the curves seem definitely in error, inasmuch as Dr. Fletcher has shown that the threshold of audibility for a 25 cycle sound is roughly 90 decibels. The decibel reading shown in Fig. 2 evidently was taken some distance away (which is not mentioned), while listening for the pulse has been done at a closer point.

If we ever attempt to write a fan noise code on the basis of listening, then we must fix the position of the operator's head and know the condition of his ears — which at best could only apply to the test room condition.

The writer disagrees entirely with the upper quiet region of Fig. 2 in that he can produce a sound of around 62 decibels at 300 cycles which is very annoying to the ear.

In general fan work one does not get the so-called throb frequency which is limited to two and three bladed propellers, the strength of the pulse being determined by aerodynamic design, particularly at the tips.

W. W. von Wittern has shown in an article on the relation between vortex noise and wind resistance that a good aerodynamic section will produce less noise than a poor aerodynamic section and that most of this noise is created at the tips.

Peak pressures and pulsating sounds can be measured and transformed into acoustic power. The acoustic power method of rating considers the fan unit as a sphere with a sound source at its center. It has been suggested that the sound level readings be taken at equal areas over a hypothetical hemisphere covering the inlet of the fan — the maximum diameter of said sphere being the diameter of the fan casing plus 6 in. on either side. The sound level readings would then be transformed into watts emitted from the source center of the sphere.

With the acoustic power output of the fan known, it can be combined with the fundamental frequency of the fan since the number of blades used is also known. The engineer or architect will then consider the fundamental and the second and third harmonics and this method will enable him to determine within reason what sound level may be expected in a particular room and what acoustical treatment is necessary to reduce this noise to the acceptable level. You cannot do this with the human element rating. —A. CURRIE, Chief Research Engineer, L. J. Wing Mfg. Co.

## EQUIVALENT LENGTH OF RUN FOR PIPE SIZING

[Note: In an article on sizing the piping for steam supply and condensate return which was published in HPAC, it was stated that the equivalent length of run is the measured distance from the boiler to the farthest heating unit, plus allowances

for fittings. A reader points out that the ASHVE Guide suggests the equivalent length as the measured distance plus allowances for fittings from the boiler to the farthest heating unit, plus the distance back to the condensate or vacuum pump. He asks which is the correct equivalent length of run to be used in pipe sizing, and says that it appears to him that the heating unit's trap should be the end of the equivalent length of run for steam supply, as steam pressure cannot penetrate this point — and that the equivalent length for the return piping should begin at the heating unit's trap, as vacuum cannot be induced beyond this point.

The author of the article in HPAC comments on this question as follows.]

As WE SEE IT, the equivalent length of pipe does not in itself define the run out to the farthest unit or to the farthest unit and return to the boiler. It is merely a method of determining the length of pipe that is to be used in calculating the total pressure drop from one point to another. The equivalent length of any given piece of pipe is its actual length, to which a number of feet of pipe for each fitting has been added. This equivalent length then can be used in determining the pressure drop from one point to another by multiplying the length by the pressure drop per foot of pipe.

Whether one uses the equivalent length of pipe from the boiler out to the farthest unit or from the boiler out to that unit and return would depend on what he is trying to accomplish. In the article, it was pointed out that a certain drop between the boiler and the unit was permissible if a certain pressure was to be maintained at the unit. The article suggested that the pipe be sized so that the pressure drop in the pipe from the boiler to the unit would not be greater than the difference in pressure between that maintained at the boiler and that wanted at the heater.

There are many different types of return systems and each must be handled in a different fashion. There are systems that operate without traps, there are systems that have traps with a gravity return and there are systems using traps with a vacuum return. High pressure systems may use bucket traps with pressure returns. It can be seen that there is not one single rule that can be made to cover every possible combination.

The pipe sizing tables in the ASHVE Guide are based on a given pressure drop for 100 ft of pipe. The tables themselves have nothing to do with the method of calculating the equivalent length of pipe, but rather indicate that 100 ft of equivalent pipe will have a given pressure drop.—R. G. LUBINSKY, Fan & Blast Coil Dept., The Trane Co.

## SUPPORTING A HORIZONTAL TANK

I WAS NATURALLY very much interested in Hrant H. Yousoufian's solution to the tank support problem published in the November HPAC. My solution to the same problem, in the June HPAC, was very conservative. I had not read Mr. Timoshenko's book on elastic stability, to which Mr. Yousoufian referred. Had I known about his formula giving critical buckling stress in curved shells, no doubt I would have arrived at a similar solution.

Mr. Yousoufian modifies Timoshenko's equation after stating that "extensive experimental work has demonstrated that the numerical coefficient in Equation 1b should be taken between 0.15 and 0.35 instead of 0.6 — the value which is indicated by theory alone. Selecting the conservative value, the equation is altered to:

$$S_{cr} = 0.15E\ (t/R)\ \ldots\ldots\ldots [1c]''$$

$S_{cr}$ is the critical stress, psi. $E$ is Young's modulus of elasticity, psi. $t$ is the thickness of the shell, in. $R$ is the radius of the shell, in.

Using this equation, he calculates that his Method 1 (one support at each end of the tank) would be satisfactory, giving a factor of safety of about two. But, for some reason, he does not recommend this method of supporting the tank.

Since his formula is rational and since it has been modified as a result of experimental work, one would think that a factor of safety of two would be enough. A factor of safety of two is commonly used with Euler's formula for buckling in a column.

Method 1 (one support at each end of the tank) is much to be preferred to the other methods because it requires no stiffening rings. The head provides the stiffness to prevent buckling over the support.

I believe it would be convenient to develop Yousoufian's Equation 1c a little further to give the distance between supports directly. The stress in the shell of a freely supported tank is given by:

$$S = d\ (4st/D + 1) \times (\pi\ D^2/4)\ (L^2/8)\ (4/\pi\ D^2\ t)$$

$S$ is the stress in the shell, psi. $L$ is the length between free supports, in. $t$ is the thickness of the shell, in. $D$ is the diameter of the shell, in. $d$ is the density of the fluid in the tank, lb per cu in. $s$ is the ratio of the density of the material in the shell to the density of the fluid in the tank.

$$S = d\ (4st/D + 1)\ (L^2/8\ t)$$

In order to apply a factor of safety of two, let: $2\ S = S_{cr}$. From Equation 1c and the above:

$$2S = S_{cr} = 0.30\ E\ (t/D)$$
$$= d\ (4\ s\ t/D + 1)\ (L^2/4\ t)$$
$$L^2 = 1.2\ E\ t^2/d\ (4\ s\ t + D)$$

In our tank problem, $d = 0.0362$ for water, $S = 7.8$, $E = 30{,}000{,}000$, $t^2 = 0.0625$, $4\ s\ t = 7.8$, $D = 130$. Therefore, $L^2 = 1.2 \times 30{,}000{,}000 \times 0.0625/0.0362 \times 137.8 = 451{,}000$, and $L = 673$ in. $= 56$ ft. One support at each end of the tank thus should be satisfactory.

In my recent article published in the September HPAC, *How to Space Supports for Large Diameter Thin Wall Pipe*, I gave a semi-rational method of spacing pipe supports. This method is refined considerably over that given in the article that was published in the June issue.

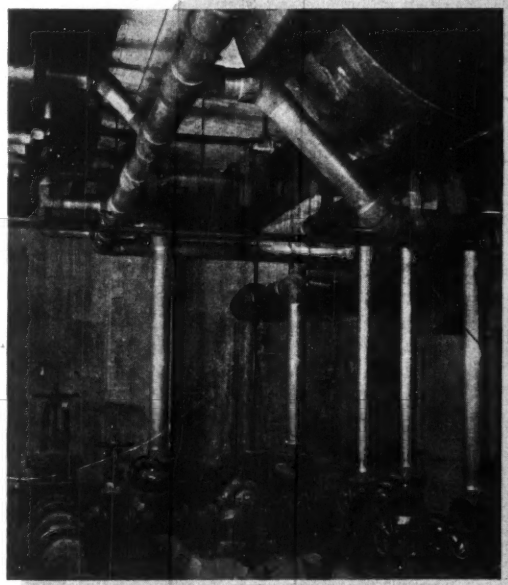
Fig. 1 in September would indicate, for a freely supported tank, 130 in. diameter and ¼ in. wall thickness, that the supports should be spaced not over 45 ft apart. So my later article gives a more reasonable answer. It is still conservative when compared to the answer obtained by use of the more rational Timoshenko formula.

I wish to thank Mr. Yousoufian for his work on this problem. It has no doubt helped others — as it has helped me — to a better understanding of the problem. — THEODORE E. BRIDGE, United Engineers & Constructors, Inc.

* * * * *

*To keep up-to-date on new and improved equipment, read the Equipment Developments and Recent Trade Literature departments, which are published regularly in HPAC.*

# Now, it makes more sense than ever to use...



**ONE VITAL SPOT** where Revere Copper Tube can be used is in the conveying of liquids in industrial processing. Here is just the place for Revere Copper Tube to show its true worth. For it is non-rusting and will resist the corrosive action encountered in many of the process applications.

**UNDERGROUND** Revere Copper Water Tube resists the corrosive action of water inside and that of the soil on the outside. It can be bent around obstructions; made to follow the contours of the ground. Its long sections, which may be had in coils, are easier to handle, require fewer fittings.

# COPPER WHERE IT COUNTS!

USING Revere Copper in the vital spots has always made common sense. Now, with copper restricted for some uses and limited for others, it becomes even more important to use "Copper Where It Counts!"

Three of these places are: industrial process lines, underground service lines and for domestic hot and cold water lines. Revere Copper Water Tube can be used for these purposes. So, whether you are a contractor, engineer or builder it will pay you to specify and use what copper you *can* get where it will do you and your customers the most good. That means in the spots where rustable materials can't stand the gaff.

Revere Copper Tube is non-rusting, has high corrosion resistance, is easily worked, installation costs are no more than for short-lived materials. It is joined with solder or compression fittings. Revere Copper Tube is ideal for replacement as it is readily bent, requires fewer fittings. It is available in hard and soft tempers, in straight lengths; also in 60′ coils in soft temper. Each length is marked with the name Revere. Look for this mark. It assures uniform quality.

To maintain your reputation for top-quality jobs, while metals remain short, use Revere Copper Water Tube wherever you can. The Revere Technical Advisory Service will be glad to help you in every way possible. Avail yourself of this service through your Revere Distributor. Call him today.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

230 Park Avenue, New York 17, N. Y.

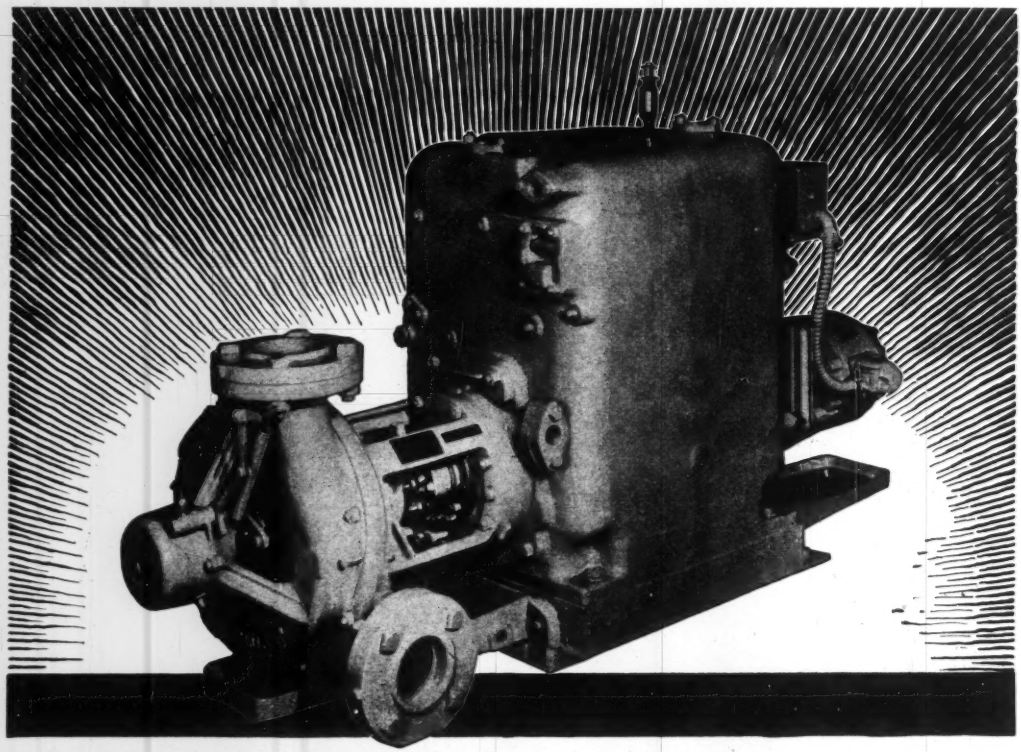
• • •

*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere*

**SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY**

# *Safety!*

## THE NASH VAPOR TURBINE HEATING PUMP IS NOT STOPPED BY ELECTRIC CURRENT FAILURE



For service in greenhouses, hospitals, schools, theatres, and public buildings, where heat failure is a serious matter, the Nash Vapor Turbine Return Line Vacuum Heating pump should be specified, for this pump operates perfectly without electric current.

This is because the motive power is a special turbine operating on steam direct from the heating system. Steam used to drive the Vapor Turbine is returned to the system for heating, with little heat loss.

This pump insures constant heat in the system, it eliminates electric current cost, and it promotes high efficiency in the heating system. Heating efficiency is due to the fact that this pump can operate continuously with economy. Continuous operation means uniform circulation, and uniform conditions in the system mean steam saving.

This pump has but one moving part, no internal wearing parts, and requires no internal lubrication. Bulletin D-246 tells all about it, and it is free on request.

## THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

# How To Justify an Industrial Air Conditioning Investment

By Peter J. Marschall
Chief Engineer
Abbott Laboratories

**The ingenuity of the engineer affects greatly the first costs and annual costs of air conditioning, heating and ventilating systems in an industrial plant. His ingenuity is not necessarily limited to technical matters, but may also be applied to selling — for example, "selling" a complete system of air conditioning in lieu of an installation which will do only a partial job**

THE PROBLEM OF justifying an investment in air conditioning deserves careful attention. It is not always possible, for example, to place a *specific* dollars-and-cents value on air conditioned space as compared with non-air conditioned space in an industrial plant, and the method of making a reasonable estimate of the value is sometimes a puzzler.

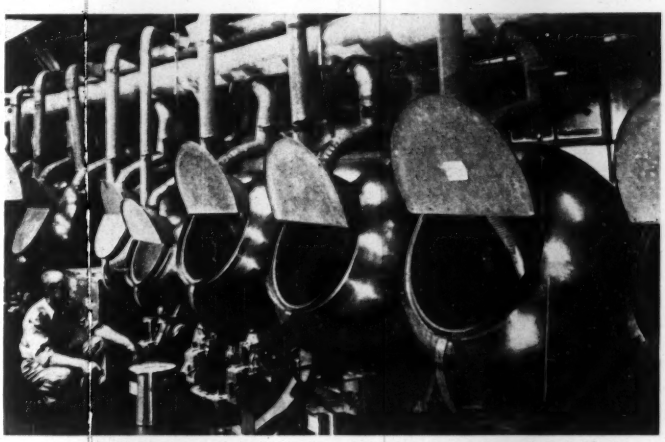
## How a Particular Case Was Solved

We had a recent experience along these lines when a department manager wanted to know how much it would cost to air condition his department and if the cost could be justified by the resulting advantages. The method we used should prove of aid in similar situations.

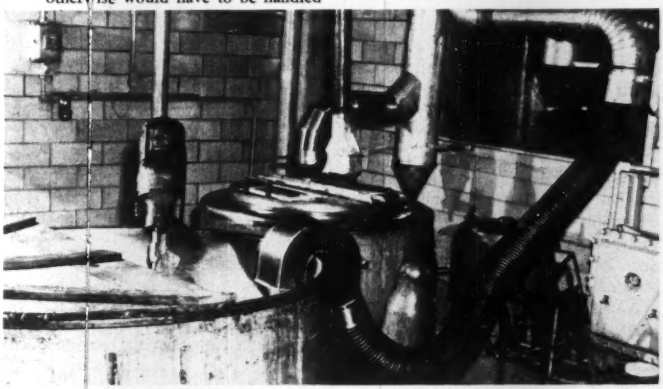
The cost of the installation was estimated at approximately $20,000. There was also a very good possibility that this department would be relocated in about two years. The problem was then to justify the amortization of this expenditure plus operating cost in a two year period.

In going over the production records, it was very difficult to find any correlation between temperature and humidity and production. During the summer months, we have the problem of vacations and replacement with temporary help who are less experienced so we would normally expect a drop off in production during the warm weather.

Failing to assemble any facts from production records, we decided to compare this investment with the



COATING PANS have individual conditioned air supply and individual exhaust ducts, as well as doors, to economize on the amounts of air which otherwise would have to be handled



MIXING TANKS with hinged covers, each with its flexible exhaust duct connection, have resulted in important savings in ventilation costs at Abbott Laboratories

payroll of the department. The salvage value of this equipment at the end of a two year period was estimated at $9000, which left $11,000 to be written off in a period of two years. The owning and operating costs were set up as follows:

| | |
|---|---|
| Amortization, $11,000 for two years | $5500 |
| Amortization, $9,000 for 15 years | 600 |
| Interest, insurance & taxes (3% x 20,000) | 600 |
| Maintenance, 40 tons @ 2.00/ton | 80 |
| Power & water, 1000 hr @ 0.68 | 680 |
| Total per year | $7460 |

Based on air cooling being required over at least a five month period per year, we arrive at a monthly cost of $1500.

### 4 Percent Productivity Increase Pays For It

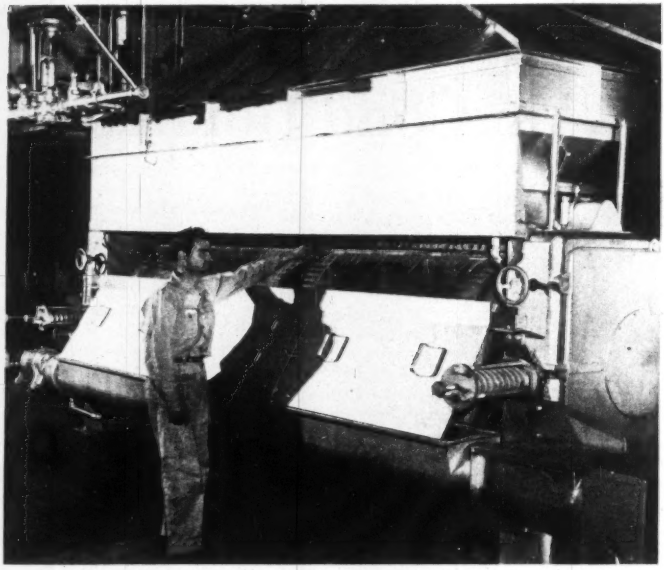
The monthly payroll for the department was approximately $40,000. Therefore, with an increase in efficiency in this department of less than 4 percent for the five month period during each of the two years, we could break even on this investment.

While it is difficult, if not impossible, to predict the increase in productivity due to air conditioning, I am sure that most of us would agree that an increase of 4 percent (a reduction in lost time of only 20 minutes in an 8 hr day) is not an unreasonable expectation. We also expressed the owning and operating costs of this system in terms of hourly wage. This figure turned out to be 1.7c per hr per worker in the department.

On this basis, we did not have any difficulty in selling management on this investment.

Incidentally, later on during the cooling season we had to plan a shutdown for this system for half a day. The manager of the department was consulted and the people in the department were notified. None of us expected any adverse effects. Much to our surprise, within an hour after the employees had started work this particular morning, complaints began to pour in. These complaints were not based on personal discomfort but were due to an appreciable drop in production of the item being assembled.

Investigation revealed that the parts being assembled by these girls were sufficiently affected by the high temperature and humidity to reduce the rate at which they could be satisfactorily assembled. Prior to the installation of the air conditioning system, the drop in production would probably have been attributed to a number of factors other than temperature and humidity. We therefore accidentally found another saving which further justified the owning and operating costs of the air conditioning system.



THIS ROTARY DRUM DRYER for penicillin mold has an individually designed exhaust hood which reduces the total air requirements of the installation

### Plan Air Conditioning in the Early Stages

A very important qualification which I believe every engineer should have in order to design the most effective and economical system is that he possess and demonstrate an inquisitive mind. The need for the services of the air conditioning engineer in connection with industrial layouts is created by the process engineer, the industrial engineer, and the production engineer. These men are primarily concerned with production layouts and methods. The heating, ventilating and air conditioning engineer is too often brought into the picture after these engineers have completed their phase of engineering (as a matter of fact, he may not be called in until after the process is in operation.)

The air conditioning engineer should be consulted in the early stages of planning. It is at this stage where one's inquisitive mind and engineering ingenuity may point out the need for a change in production layout or production methods which could easily result in the lowest overall cost together with highest quality production.

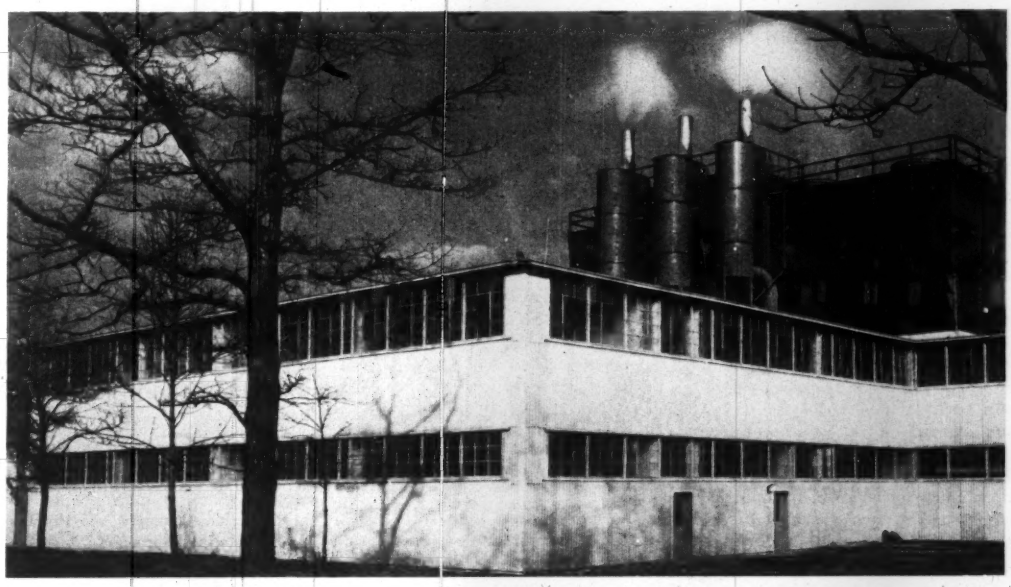
Here are some of the questions which the engineer should ask the owner before planning the design of any heating, ventilating or air conditioning system in order to attain the lowest overall cost.

1) What is the possibility of future expansion due to increased demands for the products?

2) What is the possibility of revising manufacturing methods and/or designing enclosures which will reduce the ventilation or air conditioning requirements?

3) Could other materials be substituted in the manufacturing process, thereby eliminating the need for process exhaust?

In view of the fact that industry is becoming more aware of the value of controlled air conditions within its plants to insure low cost quality production, it becomes increasingly important for the engineer to do a real job of design of the industrial ventilating systems. To satisfy the make-up requirements of an overdesigned exhaust system may severe-



DUST ELIMINATORS on one of the Abbott Laboratories buildings for removing dust from the air exhausted from drum dryers. A cooling tower for air conditioning service is behind them

ly penalize the cost of an air conditioning system.

We had an experience in connection with the design of an air conditioning system and exhaust system for an area where tablets were compressed and capsules filled with drugs.

The original area involved was about 2000 sq ft. In studying the production records, we found that there had been a steady increase in the demand for these products, so we provided refrigeration capacity, fan, coil, and dust collector capacity for an additional 1600 sq ft. Providing this additional capacity for future growth required an additional investment of about 20 percent. This percentage is on the low side due to the fact that our estimated costs included the building of a penthouse to house the air conditioning equipment. Provision for this additional capacity did not involve a material increase in the size of the penthouse.

Our forecast of the increased production in this department was correct and in less than two years we had expanded this system to its full capacity.

Incidentally, I might say that in our type of industry, it generally does not appear to be economical to design for any estimated growth beyond a two year period as the demand for the products may change due to the development of new products or, through technological improvements, production may be materially increased per unit of floor area.

### Revised Production Methods Affect Air Conditioning

I mentioned revising manufacturing methods. The tough ventilation jobs are those in areas where the manufacturing process is on a batch scale or job lot basis. The handling of materials involved in this type of process frequently results in emission of dusts, gases and vapors which may be toxic or obnoxious or both to the operator. The materials are dumped into tanks or kettles, heated, stirred, agitated, cooled, then dug out or drawn off into open drums, then ladled or bucketed into another vessel for the next step in the process — and so on.

There are times when the increase in the production of a product is so gradual that we lose sight of the fact that today's production may be many times larger than it was five or 10 years ago. The increased production may well warrant the installation of a closed system which would prove far more economical as far as the process is concerned and would eliminate or at least drastically reduce the ventilation requirements and thereby lower the owning and operating costs.

There is certainly nothing new about the effectiveness of well designed hoods, baffles, and enclosures, yet you will see countless installations where decided improvements could be made with even smaller quantities of air.

Another experience which may be of some interest was in connection with the design of an air conditioning system for a room in which a very hygroscopic powder was to be processed. A temperature of 80 F at a relative humidity not to exceed 15 percent was required for this process. One of the problems involved in the design of this system was that of removing vapors resulting from a solvent used in the process and also the removal of dust in another stage of the process.

The area involved was not large—approximately 400 sq ft of floor area. The make-up air requirement for the dust removal system was

700 cfm. An additional 800 cfm was required to exhaust the solvent vapors.

The dust removal system could not be reduced any further so we directed our efforts towards reducing or eliminating the solvent in the process. The help of the research department was enlisted. They were told that, if the solvent could be eliminated, the first cost of the installation could be reduced about $4000 and the annual operating costs reduced about $1200. By stating these possible savings in first cost and annual savings in operating costs, the research men were able to evaluate the time to be spent on this study as well as the limitations on a possible increase in production costs for a substitute process. Fortunately, within a week they developed a new formula which eliminated the use of a solvent and at no increase in the cost of the process.

I might add that the savings quoted for this installation were very conservative as we did not include the cost of standby air conditioning equipment.

Standby equipment is, incidentally, one of the reasons for the high first cost of some industrial installations. In many of our systems, to insure continuity of operation and product quality, duplicate refrigeration equipment is usually installed.

### More Engineering for Lowest Costs

I believe it is evident that more engineering hours will be required to design a system which will result in the lowest owning and operating costs. Generally the basis for compensation for engineering work is a percentage of the cost of the installation.

The normal fees may not adequately compensate the engineer who performs the type of service I have described. It might be more equitable if the competent engineer sold his services on a per diem basis.

I might also suggest that every engineer take a training course in job methods, with particular emphasis on the following questions:

Why is it necessary?
What is its purpose?
Where should it be done?
When should it be done?
Who is best qualified to do it?
How is the best way to do it?

This training should prove to be as valuable to heating, ventilating and air conditioning engineers as it has been to the production engineer in arriving at the lowest cost and highest quality.

[This article is based on a talk given by Mr. Marschall at a recent meeting of the Illinois chapter of the American Society of Heating and Ventilating Engineers.]

# Fuel Conservation According to Season

I HAVE READ the article by Lyman R. Flook, *Plan Fuel Conservation According to Season*, which was published in the January HPAC. This article brings out an interesting thought. I agree that efforts in fuel conservation will be more effective at different periods in the heating season — particularly if intelligently applied. This is readily demonstrated if the heating system is broken down into components and the losses of these components studied.

The system may well be divided into four primary parts: buildings, including ventilation; temperature control systems; distribution; and boiler plant. The following listing shows when the losses in each of the four above categories are maximum and minimum:

*Building losses*—Maximum in winter, minimum in early fall and late spring.

*Control losses*—Maximum in early fall and late spring, minimum in winter.

*Distribution losses*—Maximum in early fall and late spring, minimum in winter.

*Boiler plant losses*—Maximum in early fall and late spring, minimum in winter.

Distribution losses tend to remain nearly constant and are therefore relatively greater when loads are low.

The analysis above agrees with the curves plotted by Mr. Flook in his article.—W. M. PETRY, Acting Head, Mechanical Engineering Dept., University of Akron.

## ATOMIC REACTOR GENERATES POWER

SMALL AMOUNTS OF electric power have been produced from heat energy released in the operation of the experimental breeder reactor, recently completed at the National Reactor Testing Station in Idaho, it was announced by A. Tammaro, manager of the Chicago operations office of the Atomic Energy Commission.

In a trial run on December 21 and 22, electrical power of more than 100 kw was generated and used to operate the pumps and other reactor equipment and to provide light and electrical facilities for the building that houses it.

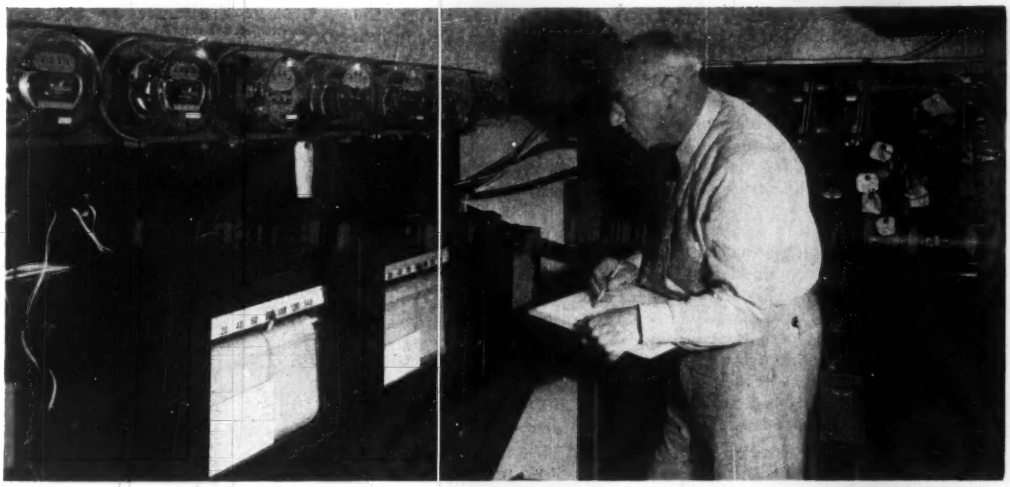
The heat energy generated was removed from the reactor by a liquid metal at a temperature high enough to generate steam to drive the turbine.

The power generation phase is incidental but is being carried out to secure experimental information on the handling of liquid metals at high temperatures under radioactive conditions and on the extraction of heat from a reactor in a useful manner. The system at the breeder reactor can never generate large amounts of electrical power but it does provide a useful tool for carrying out such experimental studies.

## 7½ MILE PIPE LINE FOR ORE CONCENTRATE

A 7½ MILE PIPE LINE has been completed by the International Nickel Co. of Canada, Ltd., through which the bulk concentrate from 3,650,000 tons of nickel-copper ore is being pumped annually from its newly-built Creighton concentrator to its reduction plants at Copper Cliff, Ont. It is believed that never before has concentrate been carried by pipe line in such quantity over such a distance. The line reduces the time required to transform nickel ore into refined nickel. The economies from pipe line transportation, with other economies, make possible working lower grade Creighton ore.

The line is part of a $130 million expansion program.



*DR. MILLS at the control and recording instruments for the reflective radiant conditioning installation*

# A Year's Operating Results for Reflective Radiant Conditioning

**By Clarence A. Mills, M.D., Ph.D.**
**Professor of Experimental Medicine**
**University of Cincinnati**

**Radiant panel cooling is a "live" subject, with a few installations in operation, several others being planned, and numerous studies of methods in progress or contemplated. Dr. Mills' work on "reflective radiant conditioning" is a most interesting phase of the general subject, and he presents here a report on a complete year's operation of his experimental installation which puts the principles to actual use**

REFLECTIVE RADIANT CONDITIONING is based upon the use of heat reflective foil coverings on all side walls and ceilings of a building. Such heat reflective wall coverings tend to eliminate winter cold wall effects on the occupants and thus the need for, or benefits from, other wall insulation. However, the reflective coverings prevent radiational heat loss from the room occupants to the walls in the summer, and thus make necessary the use of mechanical cooling in any location where summer heat is likely to be uncomfortable. Only in regions free of summer heat problems (at cool elevations and in northern latitudes) can these heat reflective wall coverings be used to reduce winter heating requirements without the accompanying installation of summer cooling equipment.

The first or laboratory phase of our reflective radiant conditioning study was described in a paper published in the ASHVE Journal Section of the November 1937 Heating, Piping & Air Conditioning. The experimental house (named "Reflection Point") in Cincinnati which puts these principles into use was described in an article in the December 1950 HPAC, and a full de-

scription of the structure was also published by the author in booklet form about a year ago. Now that the field testing phase of the study has been carried through a complete year's operation, it is appropriate that the findings be presented in some detail.

### Foil Surfaces Reflect Heat

Briefly stated, the experimental structure is of one-floor, uninsulated frame construction, with a flat built-up roof (no air space) having a 4 ft overhang on the north and south. There are seven rooms. Roughly 40 percent of the exterior side wall exposure is of single pane glass, mostly ¼ in. plate. All walls and ceilings are papered with tinted and embossed foil wall coverings.

A layer of foil also lies on the concrete floor, under the waffle-design foam rubber underlay and nylon carpeting. Milium draperies — satin cloth aluminized on the surface facing the room — cover all windows except those of the kitchen and study, which are draped with a foil-yarn-faced nylon cloth.

Aluminum lined troughs — visually similar to indirect lighting coves — encircle each room 12 in. down from the ceiling, carrying "Freon" cooling coils near their bottom and an electrical heating element slightly higher up (but shielded from the refrigerant tubes). Centralized automatic controls and individual room switches provide control of radiant heat input into or removal from each room as needed for comfort.

### Winter Heating Data and Results

The theoretical heat loss rating of the structure at Cincinnati design conditions (0 F outdoors and 72 F indoors) is 133,000 Btu per hr when calculated according to conventional ASHVE Guide methods. Actual temperature gradient calculations carried out in early February of 1951 by U.S. Bureau of Standards engineers yield a somewhat higher figure of 143,000 Btu, which was further elevated to 152,000 Btu by a 370 cfm input of untempered outside air through the electrostatic air filter (replacing the ordinary leakage factor in heat loss calculations). Using the 152,000 Btu per hr heat loss figure, the recorded indoor and outdoor temperatures, and the wattage used for heating purposes, the daily heat required was calculated as a percentage of that conventionally expected.

Each room's heating elements were rated and current consumption was separately metered so that the heating load in each could be calculated accurately at any time. The maximal heat input capacity available with all elements in every room operating at full voltage was 25.8 kwhr, equivalent to 88,100 Btu per hr. The input could be stepped down from 25.8 to 14.5, 8.7 and 4.4 kwhr by automatic control devices activated by air sampling thermostats in the central hall. For severe cold spells, it was found necessary to supplement the living room's heating capacity with two plug-in electric radiant heaters of 1320 watt capacity each. Use of these auxiliary heaters was duly recorded and their Btu output entered into all daily heating load calculations.

Instrument recordings of temperatures were taken from some 16 stations inside and outside the structure throughout the year (including one baseboard-level wet bulb). All load or behavior calculations were based on these 24 hr recordings of indoor and outdoor temperatures and of recorded operational loads.

Winter heating data are carried in the accompanying general summary of averages classified by outdoor temperature levels (Tables 1 and 2). These data indicate satisfactory operation during the lighter heating periods at about 40 percent of the load calculated as necessary for maintaining a 72 F indoor temperature by conventional methods. For more severe winter cold, about 60 percent of the conventional heat input was required. Actually, this totally uninsulated structure would probably require a 76 F instead of a 72 F indoor temperature for comfort with conventional wallpaper and conventional heating, so we regard our calculations as ultra-conservative.

We were especially pleased to have the structure tested by the day-long blizzard conditions of November 24, 1950, when a high west wind and temperatures down to 4 F provided real heating stress. Under such difficult heating conditions, comfort was achieved at only 55 percent of the calculated load (and this with an 18 month old grand-daughter playing around on the floor). There was no infiltrative chilling on the west portion of the structure — instead, there was comfort directly adjacent to the westernmost walls.

For the 141 heating days (with outside mean temperatures below 65 F) from September 24 to March 31, the average heating requirement was only 60 percent of the calculated. Not included in this period were February 3rd to March 8, when the structure was unoccupied.

**TABLE 1—SUMMARY OF HEATING data at "Reflection Point," September 24, 1950, to March 31, 1951**

| Mean daily temperature, F | | | Number of days | Actual heating load as percent of calculated for a 72 F indoor temperature |
|---|---|---|---|---|
| Outdoor | | Indoor* | | |
| 0 | to 9 | 60 | 2 | 62 |
| 10 | to 14 | 65 | 4 | 59 |
| 15 | to 19 | 68 | 2 | 62 |
| 20 | to 24 | 66 | 12 | 55 |
| 25 | to 29 | 68 | 15 | 66 |
| 30 | to 34 | 68 | 21 | 68 |
| 35 | to 39 | 69 | 29 | 66 |
| 40 | to 44 | 67 | 12 | 62 |
| 45 | to 49 | 68 | 8 | 66 |
| 50 | to 54 | 68 | 10 | 38 |
| 55 | to 59 | 69 | 15 | 50 |
| 60 | to 64 | 71 | 11 | 32 |
| 0 | to 64 | 68 | 141 | 58.2 |

*Living room baseboard level.

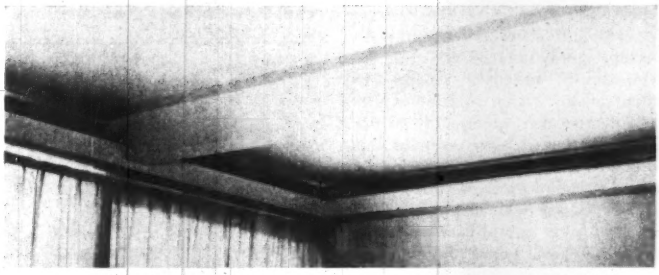
**TABLE 2—DATA FOR DAYS with outdoor mean temperature below 50 F, September 24 to January 10**

| Mean daily indoor temperature* | Number of days | Actual heating load as percent of calculated for a 72 F indoor temperature |
|---|---|---|
| 60 | 2 | 58 |
| 61 | 4 | 59 |
| 62 | 8 | 59 |
| 63 | 8 | 63 |
| 64 | 19 | 62 |
| 65 | 15 | 62 |
| 66 | 13 | 62 |
| 60 — 66 | 69 | 62 |
| 67 | 11 | 63 |
| 68 | 8 | 64 |
| 69 | 11 | 67 |
| 70 | 12 | 68 |
| 71 | 5 | 73 |
| 73 | 1 | 87 |
| 67 — 73 | 48 | 67 |

*Living room baseboard level.

### Electrostatically Cleaned Ventilation Air

This was achieved with 370 cfm of untempered outside air pumped in through the electrostatic air cleaner day and night. With outdoor air temperatures below 40 F, this volume of air input caused noticeable chilling in the central hall — hence, we tried reducing the volume to 100 cfm on December 13. This reduction made a distinct difference in hall temperatures and ease of maintaining comfort elsewhere in the structure.



THE "FREON" COOLING COILS and the heating elements are installed in coves near the ceiling, are invisible to the occupants

However, a slightly increased infiltration of outside dirt, especially through the cracks around the lower door margins, seemed to occur, so on December 27 the rate was again set at 370 cfm.

Almost complete freedom from neighborhood dirt and grime has been achieved by our pressurizing use of the electrostatic air cleaner. On occasions with 50 people in the house for 3 hr (most of them smoking), complete air freshness has been maintained and the last traces of smoke eliminated within ½ hr of their departure. This was with an air input of 1000 cfm. On one occasion, with 75 people in on a rainy day, there was a distinct build-up of body odors within ½ hr at an air input of only 370 cfm. For ordinary occupancy, 370 cfm seems ample for all ventilating and pressurizing needs in this 17,000 cu ft structure.

It would seem wise to temper the incoming air somewhat before passing it through the electrostatic air cleaner, in order to obviate its chilling effects in the central hall. This will be done before another winter comes around, with provision for heating this incoming air when outside air temperatures fall below 40 F.

Smoke tests on air travel within the structure demonstrated (1) that there is active exfiltration wherever a door or window is opened a crack on any exposure; (2) that, with doors open and the heating current "on" in any room, warm air from near the ceiling flows out into the central hall, mixes with the incoming outdoor air and recirculates back into the room near the floor; (3) that there is thus set up a positive circulation of air between each room and the central hall; (4) that this circulation is reversed when the room heating elements are "off" and (5) that there is practically no air movement along the outer wall surfaces, for smoke blown there largely stagnates.

This last fact seems of great importance in attempting to account for the structure's reduced heating requirements for it means that a minimum of air heat will be transferred to wall materials and passed on outward. This condition is the exact reverse of more conventional heating practices, where efforts are made to heat cold walls by washing them with warm air currents. In this structure, actual wall temperatures are of little importance, since these surfaces are only acting as mirror-like reflectors of the radiant heat within the room.

Actual operations at indoor temperatures as low as 46 F have convinced us that provisions should be made to prevent daytime indoor air temperatures from falling below 60 F, since air colder than this feels chilly when a person is in motion around a room. This will mean preheating of incoming outside air as well as stepping up of the radiant heat input into the rooms whenever inside air temperatures drop below the 60 F level.

Heating loads for some 129 days when outside mean daily temperatures were below 50 F were classified according to mean daily temperatures maintained indoors (at baseboard level in the living room). Table 2 sets forth these groupings and shows clearly the loss in operational efficiency as indoor mean temperatures rise to 70 F or above. Even at 70 F, however, the heating load was but two-thirds of that expected on a conventional basis. Much of this load saving undoubtedly arose from the fact that cold outside walls or ceilings no longer behaved as cold walls but rather as heat radiating surfaces (because of their high heat reflectivity). For winter radiant heating purposes, the foil wall coverings thus fulfill most of the function of in-the-wall insulation. It is largely this warm wall effect which enabled us to achieve bodily comfort at plus-or-minus 10 F lower indoor air temperatures than would have been possible if conventional wallpaper and heating had been employed.

### Rug and Floor Temperatures

Rug and floor temperatures have exhibited a most interesting behavior. With full heat on in all rooms, air temperature near the nylon carpet in the living room was 62 F but the carpet itself was at 76 F. Even near the outer wall baseboard, the carpet was 74 F. Kitchen and central hall floors of uninsulated tile were at 65 F. Obviously, therefore, the rubber matting and foil layer between the carpeting and the uninsulated concrete slab perform a very useful function. The nylon carpet here becomes an effective secondary radiator of the radiant heat it receives from the ceiling units. During our summer cooling experience, carpet and furniture fabric temperatures were regularly 2 to 3 F below those of the contiguous air. During winter heating, carpets and furniture fabrics constitute the warmest materials in the room.

Inner surfaces of outside walls maintained winter temperatures well *below* those of the contiguous air at whatever level above the floor readings are taken. Surface temperatures on inside walls were always several degrees *above* those of the contiguous air.

There had been many predictions that we would encounter troublesome vapor condensation on the broad single plate glass windows, but such occurred only briefly at the time of very sharp temperature drops and practically complete vapor saturation of outside air. Even then it was

### MANY APPLICATIONS

According to Dr. Mills, reflective radiant conditioning principles have many possible applications, including residences, apartment houses, hotels, ships, planes, automobiles, military tanks, boiler rooms and other radiantly "hot spots".

noticeable only behind drawn draperies and rapidly disappeared when the draperies were pulled open. Indoor humidity has presented no unusual problems of any kind either winter or summer.

### The Summer Cooling Studies

Summer cooling performance of the experimental structure has fulfilled most of our expectations. Untested theory had originally indicated that summer cooling with reflective radiant conditioning should be accomplished with only 20 to 25 percent of the cooling load calculated to be required for cooling by conventional air conditioning — it was this hope of lower cost summer cooling which motivated the entire experimental project, for the major part of mankind needs cooling more than heating. It is particularly gratifying, therefore, to have achieved adequate comfort cooling during the summer heat at only a fraction of the cooling load this structure was calculated to need with more conventional methods.

The structure was calculated to need 7.3 tons of refrigeration to maintain an 80 F dry bulb and 67 wet bulb indoor condition with 95 F dry bulb and 77 F wet bulb outside (a heat gain rate of 87,500 Btu hr). Our 1.5 tons of refrigeration maintained an 82 F indoor temperature when it was 95 F outside, 83 F indoors when it was as high as 98 F outside, and 86 F at 103 F outside! Of course, we did not achieve the reduction in indoor humidity which complete air conditioning gives, but this lack was counterbalanced from the comfort angle by the high degree of radiational cooling obtained.

In Table 3 are set forth the radiational cooling data obtained during the summer of 1951. [The structure was vacant and without cooling from June 20 to 27, and from July 20 to August 8.] During the 43 days here listed, the cooling was "on" in all rooms for at least 4 hr each day and there was ¼ to ½ in. of water on the roof. Outside temperature readings were taken from an aluminum-shielded element located on the south side of the structure under the 4 ft roof overhang. These summer outside readings on most days showed a higher afternoon maximum than those officially recorded above the downtown federal building or at the Abbe observatory in nearby heavily-wooded Clifton. This was to be expected, since summer daytime air temperatures *near the ground* are often sharply higher than 50 to 100 ft aloft and they are usually higher in an unshaded area such as our structure occupies than in a heavily wooded section such as Clifton. On one 97 F day, our maximum coincided with the federal maximum, and on the summer's hottest day the peak reached at the structure was 102 F while the wooded Clifton area showed 103 F. We feel justified, therefore, in making our computations wholly on the basis of our own temperature recordings.

Indoor temperature records used were those derived from aluminum-shielded elements located at the baseboard and 7 ft levels in the living room. In order to derive a living-level temperature (LR in the table) the baseboard and 7 ft readings were averaged. Wet bulb and dry bulb readings at the baseboard level were used for calculating the relative humidity at night-time minimal and daytime maximal temperatures. The relative humidity percentages shown in Table 3 are thus those prevailing at baseboard level at the time of the daily dry bulb temperature maximum. It should be borne in mind that these relative humidity percentages would diminish considerably at progressingly higher levels within the room, both because of rising air temperatures and because of heavy condensation on the "Freon" coils in the coves near the ceiling.

From the data presented in Table 3, it is evident that the amount of effective indoor cooling increases as outdoor temperatures mount progressively higher. At outdoor temperatures above 95 F, this resulted in an average difference of 15.7 F between indoors (at the 4 ft level) and outdoors — as much of a temperature contrast as is usually recommended at this latitude in conventional air conditioning. Indoor temperature did not exceed 85 F when that outdoors rose to 102, a 17 F difference.

### Water on Roof Adds to Comfort

Not all of these differences between indoor and outdoor temperatures are due to the cooling system, for this structure — like all others — itself offers resistance to heat flow inwards. Table 4 indicates the extent of this resistance at moderate and high summer temperatures, with and without water on the roof. Curiously enough, a layer of water on the roof did not lead to an increased lowering of indoor air temperatures as one would expect, perhaps because of the 370 cfm of outside air being pumped through the structure day and night.

Water on the roof did make a great difference in human indoor comfort however, even though it had

**TABLE 3—RADIATIONAL COOLING data for summer of 1951**

| Temperatures, F | | | Rel. hum. (percent) | |
|---|---|---|---|---|
| Outside max. | L.R.* max. | Diff. | at temp. max. | Cooling, hr |
| 84 | 77 | 7 | 78 | 4 |
| 84 | 76 | 8 | 74 | 4 |
| 84 | 73 | 11 | 91 | 5 |
| Aver. | 75.3 | 8.7 | 81 | 4.3 |
| 86 | 78 | 8 | 78 | 7 |
| 86 | 78 | 8 | 82 | 5 |
| 86 | 81 | 5 | 91 | 5 |
| Aver. | 79 | 7.0 | 84 | 5.7 |
| 87 | 81 | 6.0 | 83 | 8.0 |
| 88 | 78 | 10 | 74 | 7 |
| 88 | 78 | 10 | 78 | 10 |
| 88 | 78 | 10 | 87 | 10 |
| 88 | 79 | 9 | 75 | 9 |
| 88 | 79 | 9 | 87 | 9 |
| 88 | 79 | 9 | 75 | 6 |
| Aver. | 78.5 | 9.5 | 79 | 8.5 |
| 89 | 83 | 6 | 80 | 10 |
| 89 | 83 | 6 | 80 | 11 |
| Aver. | 83 | 6.0 | 80 | 11.5 |
| 90 | 81 | 9 | 79 | 15 |
| 90 | 80 | 10 | 83 | 8 |
| 90 | 80 | 10 | 83 | 12 |
| 90 | 80 | 10 | 83 | 11 |
| 90 | 80 | 10 | 78 | 7 |
| 90 | 79 | 11 | 87 | 6 |
| Aver. | 80.0 | 10.0 | 82 | 10.0 |
| 91 | 79 | 12 | 83 | 10 |
| 91 | 80 | 11 | 75 | 9 |
| 91 | 81 | 10 | 79 | 12 |
| Aver. | 80.0 | 11.0 | 79 | 10.3 |
| 92 | 80 | 12.0 | 87 | 12.0 |
| 93 | 80 | 13 | 83 | 13 |
| 93 | 81 | 12 | 75 | 11 |
| 93 | 82 | 11 | 83 | 20 |
| 93 | 83 | 10 | 84 | 4 |
| Aver. | 81.5 | 11.5 | 81 | 12.0 |
| 95 | 82 | 13 | 75 | 13 |
| 95 | 81 | 14 | 79 | 15 |
| 95 | 83 | 12 | 84 | 10 |
| 95 | 82 | 13 | 87 | 12 |
| 95 | 84 | 11 | 88 | 14 |
| 95 | 83 | 12 | 84 | 9 |
| 95 | 82 | 13 | 87 | 6 |
| Aver. | 82.4 | 12.6 | 83 | 11.3 |
| 97 | 80 | 17 | 80 | 17 |
| 97 | 82 | 15 | 83 | 14 |
| Aver. | 81.0 | 16.0 | 82 | 15.5 |
| 98 | 83 | 15 | 83 | 15 |
| 98 | 83 | 15 | 84 | 11 |
| Aver. | 83.0 | 15.0 | 83 | 13.0 |
| 100 | 84 | 16 | 88 | 24 |
| 100 | 85 | 15 | 84 | 23 |
| Aver. | 84.5 | 15.5 | 86 | 23.5 |
| 102 | 85.0 | 17.0 | 88 | 22.0 |
| General averages | | | | |
| 84-89 | 78.6 | 8.3 | | 7.3 |
| 90-95 | 80.6 | 11.4 | | 11.0 |
| 97-102 | 83.1 | 15.7 | | 18.0 |

*7 ft and baseboard temperature readings averaged.

TABLE 4—TEMPERATURES (F) without cooling

| Outside max. | L.R. at 4 ft max. | Diff. |
|---|---|---|
| | Water on roof | |
| 73 | 74 | +1 |
| 75 | 77 | +2 |
| 77 | 76 | —1 |
| 78 | 76 | —2 |
| 80 | 76 | —4 |
| 81 | 77 | —4 |
| 82 | 78 | —4 |
| 83 | 77 | —6 |
| 85 | 77 | —8 |
| 85 | 80 | —5 |
| 85 | 79 | —6 |
| 86 | 81 | —5 |
| 88 | 83 | —5 |
| 90 | 83 | —7 |
| 93 | 85 | —8 |
| 95 | 88 | —7 |
| 97 | 93 | —4 |
| 97 | 91 | —6 |
| 98 | 92 | —6 |
| 99 | 92 | —7 |
| 100 | 90 | —10 |
| 103 | 93 | —10 |
| 73-95 aver | | 4.3 |
| 97-103 aver. | | 7.2 |
| | No Water on roof | |
| 89 | 84 | —5 |
| 89 | 85 | —4 |
| 89 | 85 | —4 |
| 90 | 85 | —5 |
| 90 | 90 | 0 |
| 90 | 89 | —1 |
| 93 | 86 | —7 |
| 94 | 91 | —3 |
| 95 | 90 | —5 |
| 95 | 86 | —9 |
| 97 | 88 | —9 |
| 97 | 87 | —10 |
| 97 | 88 | —9 |
| 97 | 92 | —5 |
| 98 | 90 | —8 |
| 98 | 93 | —5 |
| 98 | 91 | —7 |
| 98 | 93 | —5 |
| 100 | 91 | —9 |
| 100 | 94 | —6 |
| 100 | 92 | —8 |
| 101 | 94 | —7 |
| 101 | 94 | —7 |
| 102 | 93 | —9 |
| 89-95 aver. | | 4.3 |
| 97-102 aver. | | 7.4 |

no significant effect on air temperatures. Outdoor sunshiny weather up to 85 F allowed tolerable indoor comfort without having the cooling "on" if water covered the roof, but without the water there was acute indoor discomfort. This ceiling radiation with the roof dry was even sufficient to neutralize the cooling effect of the chilled "Freon" coils in the coves.

According to tests, foil wall coverings used on ceiling surfaces have a reflectivity for radiant heat of above 90 percent and an emissivity of approximately 20 percent. Even with emissivities of this order, the large ceiling areas had a major influence on whether there was to be comfort or discomfort indoors. It is then apparent that solar energy transfer through the roof must be kept at a minimum to assure successful operation of low-load radiational cooling.

While a considerable amount of solar energy is reflected by foil-surfaced roofing materials, increased resistance to heat transfer can be obtained using roofing combinations foil-faced on both sides. The combined high reflectivity of the upper surface, low conductivity of the sandwiched material, and low emissivity of the lower or inner surface of the roof add up to sufficiently effective heat blockage.

The 10 to 17 F of air cooling achieved with reflective radiant conditioning occurred only as a secondary result of the radiational cooling of rugs and furniture fabrics by direct radiant heat loss to the cove cooling coils. Air lying stagnant in the coves was cooled to 45 to 50 F, but there never occurred any spillage of this cold air out into the room proper. Room occupants thus benefited by radiational loss of body heat and by the secondary lowering of room air temperatures in contact with the cooled rug and furniture fabric surfaces.

## Comfort with Radiational Cooling

With the set-up as it is at "Reflection Point" — 1.5 tons of refrigeration for the entire structure — bodily discomfort becomes obvious when indoor air temperatures go above 82 F when the cooling is "on". With no cooling on, discomfort becomes obvious above 76 F air temperature. Conditions become perceptibly chilling for a sedentary person when the cooling is "on" at air temperatures below 74 F. It seems obvious, therefore, that bodily comfort could readily be achieved at indoor air temperatures far above the 82 F level if the cooling coil surface area could be increased or its surface temperature further reduced. In fact, our laboratory studies reported in 1937 showed radiational cooling adequate for bodily comfort in air kept at 95 F and 80 percent relative humidity.

Although air temperatures at the baseboard level usually fell to within 2 F of the wet bulb reading at night, there was no evidence of surface condensation on rugs, furniture, books, etc. at any time. Mildew — a major problem during such moist heat periods in Cincinnati — could not even be found in traces by careful search.

Pressurizing air intake through the electrostatic air cleaner has been continued at 370 cfm since late in December 1950 and was held at this level. There is no provision for precooling this incoming air in the summer.

It is significant (and to have been expected) that the fixed amount of chilled "Freon" coil surface becomes increasingly effective as temperatures rise, for there is then provided a steeper gradient for radiant heat transfer from room material surfaces to the chilled coil surfaces. Such heat transfer is proportional to the difference between fourth powers of the absolute temperatures concerned. It therefore follows that equivalent cooling could be obtained from less coil exposure if lower coil temperatures could be obtained.

## Heat Reflective Draperies Essential

The heat reflective window draperies constitute an essential part of the reflective radiant conditioning system. Both the milium-treated satin and the nylon with a foil yarn facing show an 80 percent blockage of radiant heat striking the cloth from either side. They thus exclude summer radiant heat from outside sources and retain inside radiant heat for winter comfort. In these functions they are practically as effective as a sidewall of an ordinary structure and thus allow free use of glassed areas (without double glazing). In very cold winter weather, it is necessary to bring them in close opposition with the window sill in some fashion so as to prevent the downward cascading of cold air which has been chilled by contact with the cold, single pane glass.

The radiant heat barrier effectiveness of these draperies is plainly evident in both winter radiant heating and summer radiant cooling. A room comfortably warm in zero weather with the draperies closed very quickly becomes uncomfortably chilly when they are drawn open to allow a radiant heat outflow. On a clear or partly cloudy day of summer heat, a comfortable degree of radiant cooling changes to uncom-

fortable warmth almost at once when the previously closed draperies are drawn open to let in even the secondary sky radiation (without any direct sun rays).

### Minor Heat Gains of Importance

It should be borne in mind that these more or less minor sources of summer radiant heat gain become relatively more important when we are trying to cool an uninsulated 17,000 cu ft structure with a cooling system of only 1.5 tons refrigerating capacity. Both types of drapery material do the job satisfactorily while still admitting an adequate amount of light for reading or most other usual indoor living functions.

When two thermometers — one inside a hollow blackened sphere for sensitization to radiant heat and the other with a vented aluminum foil shield — were placed in the living room in front of the south window on a hot day and the curtain was suddenly drawn open, the one in the blackened hollow sphere showed a rapid 4 deg rise. In winter cold, it showed a rapid fall. With the radiant cooling "on" in summer heat, a foil shielded thermometer, well back in the room with window draperies closed, shows a 1 F fall when the shield is removed. With the radiant heat "on" in winter cold, it shows a 3 F rise when its shield is removed.

The type of lighting has an important bearing also with the small cooling loads of reflective radiant conditioning. A 100 watt incandescent bulb emits about as much heat as an adult, and in our foil-lined rooms its radiant heat emission becomes a very obvious source of discomfort. It is highly advisable, therefore, that both types of lighting be available, fluorescent for summer use and incandescent for winter (when the heat output serves a useful function).

Reflective radiant conditioning imposes no structural requirements other than the installation of the cove around the room a foot down from the ceiling. This cove can well take on the appearance of only an indirect lighting cove, with the heating and cooling system working unobtrusively and unseen. The system does, however, make possible many structural savings, and it is believed that these may almost cover the somewhat higher cost of equipment and special materials needed. The costs should not be compared with simple winter heating, for the system provides year 'round comfort.

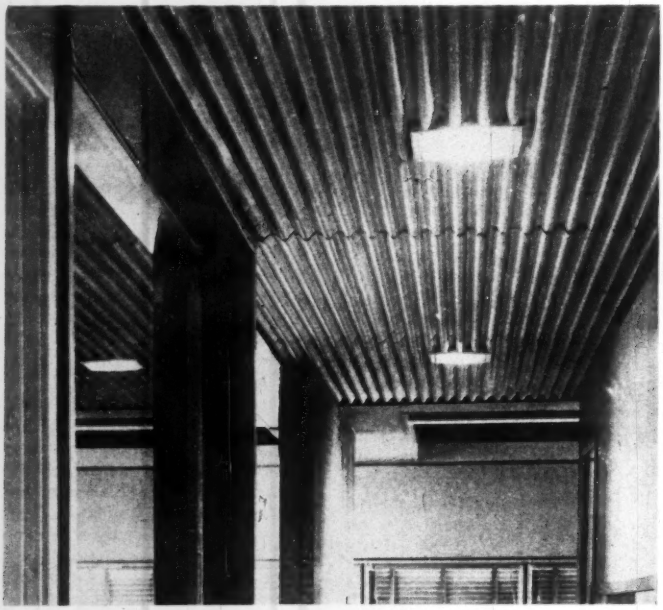
The amount of cooling exposure in the various rooms was calculated to provide cooling for 12 people in the living room, eight in the dining room, five in the kitchen and study, and three in each bedroom. Our heaviest simultaneous hot weather occupancy load has been eight in the living room and six in the study — without evidence of overloading.

Several critics have not believed it possible to remove appreciable amounts of latent heat from the room by water vapor condensation on the cove cooling coils. I was frankly surprised myself at the amount and continuity of such condensation, for (like a few others) I had not given proper weight to the tendency of any gas to maintain a uniform gas pressure in any space available. Production of a sharply reduced water vapor pressure in the cove itself sets up a rapid net flow of vapor molecules in that direction. It is questionable, however, whether the effects of such condensation produce notable drying in the presence of an untempered outside air input of 370 cfm.

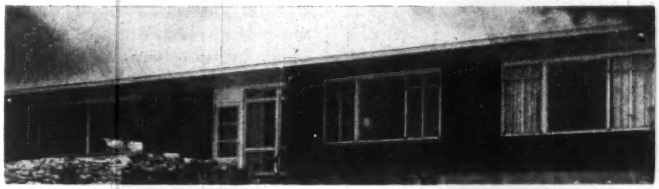
### Certain Advantages Seem Evident

It is too early yet to discuss in detail the factors responsible for our reduction in cooling load. Certain points appear evident: (1) Radiant heat inflow through walls and glassed areas is largely blocked by inside aluminum surfacing; (2) a very low degree of air motion prevents warming of indoor air in contact with warm walls, draperies, etc.; (3) less cooling load is "used up" by indoor dehumidification; and (4) the "cold wall" cooling effect derived by reflection from the cove cooling coils is a major factor in bodily comfort.

Pressurizing use of the electrostatic air filter carries certain structural and operational implications of importance: (1) It assures almost complete freedom from neighborhood dirt and odors by supplying exfiltration at all cracks or openings; (2) it prevents infiltrative winter chilling on the windy side of the house; (3) it eliminates need for weatherstripping, openable windows, and window or door screens; (4) and it gives delightful indoor freshness at all times and rapid destruction of tobacco smoke or cooking odors. For these reasons, its use is recommended



ELECTROSTATICALLY CLEANED outdoor air is introduced continuously through the perforated ceiling in the central hall



"REFLECTION POINT" was built to study in actual operation the idea of reflective radiant conditioning, is also the author's residence

even in country-clean districts, and is almost mandatory in urban areas.

Our present two types of window draperies provide adequate control of radiant heat flow in either direction through glassed areas. Either of these materials admits adequate amounts of light even when all glassed areas are completely covered, so there need no longer be any limitation on the amount of wall glassed area used. A single plate glass wall is perhaps the cheapest wall available, either for outside or inside use. Glass walls increase the feeling of spaciousness and have minimal upkeep costs, hence should be used freely. Other types of effective drapery materials are being prepared.

### Some Changes Are Planned

In order to obtain more exact data on reflective radiant conditioning, a second installation has been set up at Foster, Ohio. Here will be studied the essential necessity of the heat reflective wall coverings for both winter heating and summer cooling by this method, their advantages over conventional wallpapers in winter heating by conventional methods, and their disadvantages in summer cooling with conventional air conditioning. Instead of "Freon" coils in troughs in this installation, we have soft soldered blackened water piping onto a blackened brass trough for circulating either hot or chilled water. Preliminary studies in late summer indicated a similar radiant heat uptake between each square inch of such exposed trough surface and each square inch of exposed "Freon" coil surface at "Reflection Point."

The next step to be taken at "Reflection Point" is a change from direct electrical resistance heating and "Freon" coil cooling to a circulating hot and chilled water system in the troughs for securing radiant heat emission or absorption (and removal from the room). During last winter's electrical heating, there was considerable contact heating also of the air and a layering of this heated air up against the uninsulated ceiling where it served no useful purpose Considerably greater radiant heating efficiency could surely be obtained if the hot radiating surfaces could be separated from room air by a radiant-heat-transparent membrane. Careful testing of available plastic sheetings yielded one which possesses 90 percent transparency to radiations from 80 F and 150 F sources, although being somewhat opaque to the visual range of light wave lengths. It possesses this 90 percent transparency for such heat wave lengths at 0.004, 0.006 and 0.010 in. thicknesses. This sheeting will be tried as a double-layered cover over the new coves during this winter's heating studies.

### New Vistas Are Opened

Much yet remains to be done to round out our knowledge of the possibilities and the limitations of reflective radiant conditioning, but indications are that new vistas have been opened by this emphasis upon control of heat flow by surface reflectance and emissivity rather than by centering attention upon its transfer in kinetic (or latent) form through solid masses and air.

## Taps Power From the Sun

POWER FROM NATURE'S greatest energy reservoir, the sun, can be tapped by a new device now being demonstrated throughout the country in the General Motors "previews of progress" science shows.

Known unofficially as a "sun motor," this mechanism illustrates how sunlight can be converted into enough electrical energy to spin a balsa wood wheel on the shaft of a small motor.

If sunlight isn't available, heat of a candle or light from a 150 watt lamp does the job.

General Motors engineers admit the sun motor is an extremely low efficiency power producer for anything beyond illustrating a principle — that sunlight is power.

How to harness this power for such everyday chores as space heating, running electrical appliances or even propelling vehicles is a problem many engineers and scientists are thinking about.

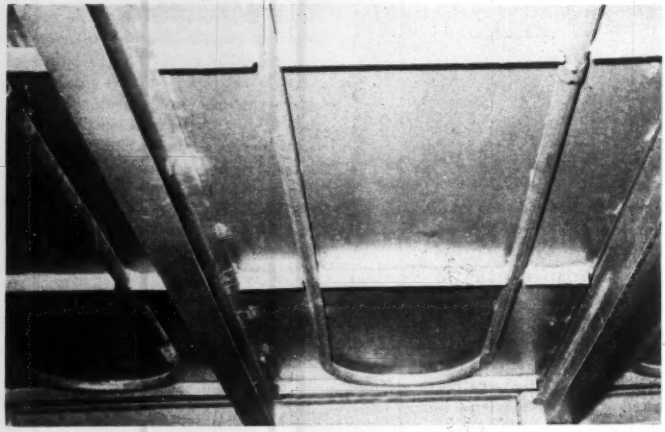
As Charles F. Kettering, former head of the General Motors research laboratories has expressed it, the problem is to "short circuit" nature and convert power directly from the sun's rays, rather than obtain it from such byproducts of solar energy as coal, petroleum or vegetable matter.

Scientists agree the sun wastes its energy lavishly. They point out that enough sunshine drenches the roof of an average one-family dwelling in 30 minutes to light, heat and run the electrical appliances in that dwelling for an entire year.

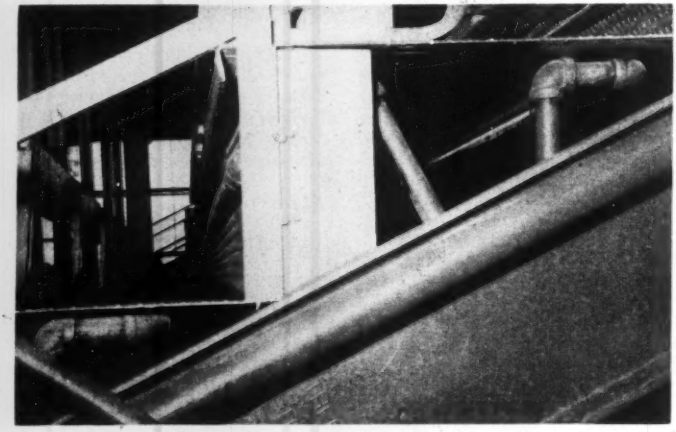
The sun motor offers no clues to the secret of the sun's vast energy storehouse. In its inefficient way it merely points out to "previews of progress" audiences that energy from sunlight is available, if it can be put to work efficiently.

The motor in this "power package," about the size of a man's fist, gets energy from either of two sources. The first is a series of photovoltiac cells. When light from a 150 watt lamp falls on these cells, a chemical reaction induces the flow of direct current electricity to the motor.

The second power source, usable if the lamp isn't available, is a candle. Heat from the candle actuates a thermopile which converts the flame heat into electrical energy.



SCREWED PIPE was welded to the steel deck plates, the method of welding determining the amount of heat passing up through the deck and that radiated down to the area under the grandstand. Notches cut in the deck plate supports allowed the pipe to be welded firmly to the plates. Screwed pipe was used due to cost of welding small diameter pipe. Hydraulic jacks were used to force the pipe in contact with the deck plate before welding them together



THERE ARE TWO PIPES under each seating deck in the bleacher section, and a third pipe on the outside of the deck riser to warm ankles and legs

# How To Heat a Grandstand

**● Pipe coils welded to undersides of steel deck plates furnish heat by conduction to space above and radiate heat to area below . . . . . J. B. McCormick, District Engineer, The Lincoln Electric Co., describes novel installation at a race track**

THE GRANDSTAND HEATING installation at Sportsman's Park, Phoenix, Arizona, is a remarkably interesting one from the standpoint of pioneering in a new field with no particular background data from which to work. Not only does the installation represent a new approach to a troublesome heating problem, but the lack of engineering data on operations of this type — involving large areas of space constantly exposed to the outside air — required research to arrive at a method of handling the problem. The firm of Clifford C. Sawyer, Phoenix, was the consulting engineer.

## Design Conditions and Results

The installation was designed to give approximately 65 deg in the bleacher and box area and 60 deg in the space below the bleachers — which houses the pari-mutuel betting counters, two lunch counters and the restrooms — with a minimum outside temperature of 35 F. The actual operating results under this condition are a 30½ deg rise above the outdoor temperature under the bleacher-box area and a 29½ deg rise in the bleacher-box area. The Btu per hr output of the heating system, as calculated and as measured in operation, is 2,100,000. The night the season opened, the outside temperature was 28 deg and yet the installation performed satisfactorily.

The grandstand — a combination of bleachers and boxes under one roof — is 232 ft long and has a seating capacity of about 2600. The heated area totals 11,562 sq ft, having 469,000 cu ft of volume.

The objective was a heating installation that would give positive, draftless and quiet heating, that could be easily serviced, and that would require a minimum amount of operational attention. A radiant type of installation was selected. The area heated was divided into two zones with separate pump equip-

ment for each, and as a further precaution, the piping is divided into 10 segments that can be drained and serviced without affecting the entire system.

One pumping system from the boiler includes feeding a three-pipe heating panel along the entire back wall of the grandstand to heat the pari-mutuel working area, and the heating panels under the box seats at the front of the grandstand. This unit has a capacity of 80 gpm with a 15 ft head.

The other pumping unit is used for the bigger and higher bleacher seating area. It pumps 140 gpm with a 20 ft head.

### Screwed Pipe Welded To Deck Plates

An unusual feature of the installation is that all screwed pipe was used, and was fastened by electric arc welding. The installation procedure was such that there was no strain and only three leaks developed in the entire 13,000 lineal ft of piping. Two of those leaks were due to factory butt-weld failures.

The entire grandstand is of all-steel construction having ¼ in. deck plate throughout. The black iron pipe has the same coefficient of expansion and contraction as does the ¼ in. plate to which it is welded. By welding the pipe it was possible to economize on the installation; more important, it was possible by welding to secure the balance needed between upward and downward heat emission.

The problem in both bleacher and box heating was to push the proper amount of heat up through the deck plates to warm those in the grandstand while at the same time allowing sufficient heat to radiate downward for comfort in the huge space under the grandstand — necessarily left open to allow free traffic through a series of swinging doors. Welding the pipe tight against the decking plates proved to be a simple solution to an involved application. The length of the weld could be made to determine the amount of heat which could be sent through the plate by conduction. In the bleacher section of the grandstand, two 1¼ in. pipe coils with 18 in. spacing are run under each seating deck and in addition, an ankle height pipe is carried along the front of the deck riser, welded to the outside, to warm ankles and legs. Three pipes also run along the full length of the front of the grandstand to send a wave of heat up along the glass panel, which extends 5 ft above the sheet metal covered railing. The warm air from these three pipes prevents body heat loss from people in the stand to the cold surface of the glass. There is a 7 ft open space between the glass and the overhang of the grandstand roof.

The box seating area is heated by 67 loops of 1¼ in. pipe welded to the deck plates. Notches were cut in the angle iron deck plate supports to allow the pipe to be welded firmly to the plates. Again the method of welding and the length of the welds took care of upward and downward heat requirements and no strain was put on the screwed pipe due to the careful method of welding. Welds average around 4 ft apart and from 6 to 14 in. in length.

The circulation in the system is the diagonal flow of the conventional grid and loop pipe system. The 67 loops require no air vents nor does any other part of the pipe welded to the grandstand decking.

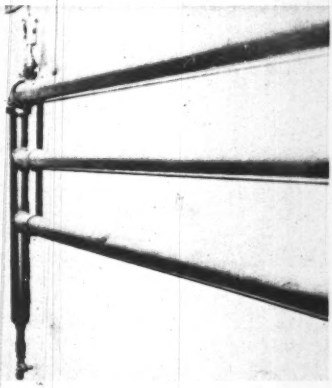
Air vents of the automatic type are installed at all high points on the feeder mains.

The full length of the cement block back wall — which is a floating wall — is heated by three pipes, the top a 2½ in. supply pipe running the full 232 ft and headered into two 2 in. return pipes. This unit is welded directly to narrow plates bolted to the cement flush with the wall surface. The plates act as small radiant heaters.

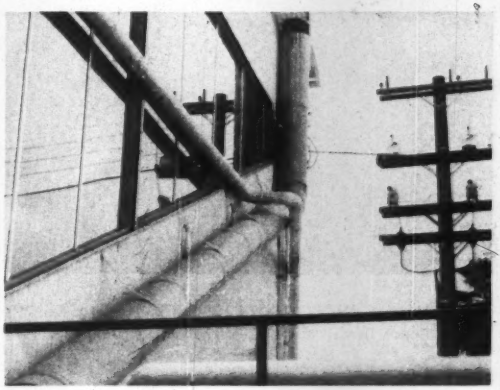
Equal flow is attained through every pipe, and the pipe bends are of the wrinkle and cut and weld types to insure maximum flow in every part of the system. Eleven thousand feet of 1¼ in., 670 ft of 2 in., 550 ft of 2½ in., 500 ft of 4 in., and 350 ft of 3 in. pipe was used.

The heating unit which supplies hot water to the pipe coils is a gas fired, double burner boiler with a capacity of 15,360 sq ft EDR.

The cost was comparative with other types of installations. On a competitive bid basis, it averaged $1.17 per sq ft of space heated. The installation was by the Welsh Contracting Co., Phoenix.



THESE THREE PIPES welded to small steel plates countersunk in the cement block back wall every 8 ft warm the betting counter area



THE STACK FOR THE gas fired boiler runs up along the exterior of the grandstand. This view also shows top of the water compression tank

# Mark Air Conditioning's 50th Birthday This Year

**First system for both humidity and temperature control designed to solve printing problem in 1902 by Willis H. Carrier . . . . Company he founded is celebrating the "golden anniversary of modern air conditioning"**

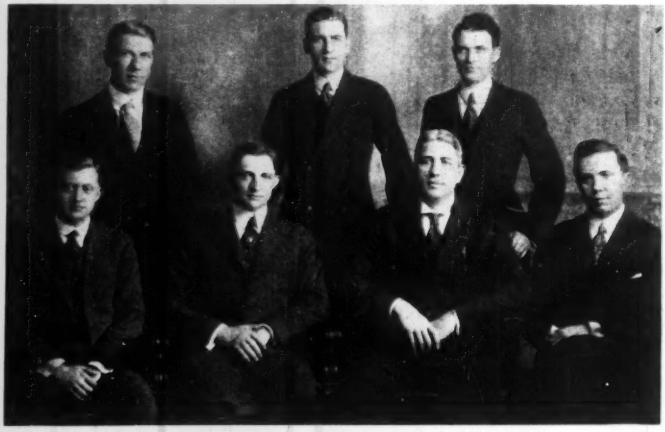
MODERN AIR CONDITIONING celebrates its golden anniversary in 1952, for the "first scientific system for controlling both humidity and temperature," in addition to cleaning and circulating air, was designed in 1902 to solve a color printing production problem at Sackett-Wilhelms Lithographing and Publishing Co., Brooklyn.

Designer of the system was Willis H. Carrier, then a young research engineer not quite a year out of Cornell University and employed by the Buffalo Forge Co. The "official birthdate" has been set at July 17, 1902—the date on the earliest-known completed drawing for the Sackett-Wilhelms system.

Born in working clothes, modern air conditioning during its first 50 years has become a symbol of American life and progress and a basic factor in the development of the highest standard of living the world has ever known.

Actually, it bore no name for at least four years of its life. In 1906 Stuart W. Cramer; a textile mill engineer, evolved the phrase "air conditioning" from "yarn conditioning" — a term widely known in the textile industry. Its derivation suggests a relationship important in many industries — that the condition of the air determines the condition of a product made from moisture-absorbing materials. The name became popular, and now is used generally to cover the entire wide range of applications which combine the functions of the original system.

As in so many great events, the birth of the industry came when it did as the result of a fortunate coincidence — the right man given the right problem at the right time. Many attempts had been made through the ages to create indoor weather tailored to human needs — most of these centering around temperature regulation. Central heating, used by the Romans, was an immeasurably important development. When Dr. John Gorrie invented the first commercially successful refrigeration machine in this country in the mid-1800's, he was seeking a way to make ice to cool the sickrooms of tropical fever patients. By 1902 Alfred R. Wolff, a consulting engineer, had designed air cooling systems for Carnegie Hall, the autopsy room of Cornell Medical College, the New York Stock Exchange board room, and the Hanover National Bank.



PIONEERS IN AIR CONDITIONING—In front row, left to right, are L. Logan Lewis, Willis H. Carrier, J. I. Lyle and E. T. Murphy. In back row are E. P. Heckel, E. T. Lyle and A. E. Stacey, Jr. Picture was taken in 1917

### Air Conditioning Is Born

Early in 1902, the Sackett-Wilhelms company raised the problem which set the capstone of humidity control upon all earlier efforts and started the air conditioning industry on its way. The company was trying to meet multicolor printing process deadlines for a number of magazines, among them the popular humorous weekly of that day — Judge. Variations in humidity were causing the paper to contract, expand or wrinkle between printings of each color, interfering with quality work and endangering production schedules. Specifications for the instal-

lation called for dehumidifying in summer to a specific moisture content — a common feature of present-day air conditioning but never before then attempted successfully.

When young Carrier was given the problem he had just completed a research program which produced the first tables ever compiled for accurate selection of fan-coil heating equipment. He turned to his familiar heat research apparatus, but this time he pumped cold lake water instead of steam through the coils, measuring the temperature and relative humidity of air entering and leaving the coils at various coil temperatures to determine the cooling and dehumidifying effect. From his figures he designed a coil to meet operating specifications for the Brooklyn printer.

The Sackett-Wilhelms system was operating by late 1902. Design conditions were 80 deg and 55 percent relative humidity in summer, and 70 deg and 55 percent relative humidity in winter. Cooling and dehumidification coils were arranged in two stages, the first stage using cool well water, and the second designed for direct expansion ammonia cooling. Total capacity of the system was 56 tons, with well water providing 26. In winter, moisture was added to the air under automatic control by means of perforated steam pipes.

Complete air conditioning had become a fact for the first time.

### Spray Type Apparatus and Dew Point Control

Carrier's restless genius, stimulated by the challenge, pushed on to better ways of doing the job and to new applications. In 1904 he developed the spray type apparatus, conceived on a fog-shrouded railroad platform in Pittsburgh. It had occurred to him — as he watched the drifting mist — that a man-made spray could be used to control the moisture content of the air — either adding or removing according to the spray temperature.

In 1906 he installed the first central station humidification and humidity control system in the textile industry at Chronicle mills, Belmont, N. C. During this installation he discovered that a constant dew point depression produced a constant relative humidity. And this led to further development of his idea for control of humidity through control of spray temperature. In that same year he filed a patent for his dew point control system. In this system, a thermostat was placed in the air stream leaving the spray chamber where the temperature of the air was also its dew point, since the air was saturated. The thermostat varied spray temperature to obtain the desired dew point.

In 1907 the first automatic humidity control system using a constant dew point depression was installed at the Huguet silk mills, Wayland, N. Y. The original apparatus for this first central station silk mill conditioning system is still in place in Wayland. In that same year, Parke Davis and Co., Detroit, obtained a Carrier design for cooling and dehumidifying a room where capsules were manufactured — the first air conditioning system for the pharmaceutical industry.

In 1908 air conditioning entered the chemical industry with an installation at the Celluloid Co., Newark, which manufactured celluloid film base for the infant moving picture industry. The problem was that moisture condensed on the film base during evaporation of solvent, and produced the white specks so familiar to early moviegoers. A dehumidifier was used to lower the dew point of the air, preventing moisture condensation. Refrigeration for this system was supplied by the York Mfg. Co., which subsequently became York Corp. and is now one of the major air conditioning manufacturers.

In 1910 the rayon industry — new to this country at the time — obtained its first air conditioning system with an installation at the American Viscose Co., Marcus Hook, Pa. In 1911 a pharmaceutical plant installation with a special new type of air distribution providing individual conditioning for each of a number of capsule-forming machines through a central station system was designed by Willis Carrier for Eli Lilly and Co., Indianapolis. A static pressure regulator was employed to maintain a constant flow of air when a portion of the machines were shut down. This installation is still in use.

Also in 1911, air conditioning entered the electrical manufacturing industry with an installation for the Bosch Magneto Co. machine shop, Springfield, Mass. In that same year it was introduced to the candy industry with an installation at the George Ziegler Co. plant, Milwaukee.

### "OPPORTUNITY UNLIMITED"

"The curve of the air conditioning industry started its real rise only within the past decade, and I feel sure that the present growth period has a very considerable distance to run. We have only scratched the surface of such vast potential markets as homes, offices, stores and industrial plants.

"My belief is that, for a long time to come, our growth will depend largely upon our ability to provide a sufficient number of highly skilled people and upon our ability to finance expansion.

"My belief is also that our equipment of the not too distant future will be lighter in weight and more compact, will operate at higher speeds, greater efficiency, and with less noise, but will sell for less.

"I believe that we will be able to create indoors the long-sought 'environment free of irritation,' no matter what the irritant now is — noise, odors, drafts or price.

"Actually, all this should be possible of achievement without major extension of our present fund of basic knowledge. Yet this knowledge is by no means complete. Our pioneering days are far from over. New ideas are constantly taking shape. And when, through research, we can know more about the effects of air conditioning on human productivity, on health and the treatment of disease, on various types of industrial production — then we will have an even broader base on which to build.

"In short, when we look at these next 50 years we are looking at opportunity unlimited."—— Cloud Wampler, President, Carrier Corp.

STYLES HAVE CHANGED—and it's just as well, we think — since the year the Rivoli theater installed air conditioning

to the baking industry with an installation for the Collins Baking Co., Buffalo, and to the laboratory field with an installation at the Thomas A. Edison, Inc., film processing rooms, Orange, N.J.

### Psychrometric Formulas Are Presented

Probably more important than any other air conditioning event of that year, however, was the unfolding of Willis Carrier's rational psychrometric formulas, which have served ever since as a basis for air conditioning calculations. Presented in a paper before the American Society of Mechanical Engineers, they covered the principles of air conditioning. At this meeting, Carrier also presented another paper, which he and Frank L. Busey of Buffalo Forge had co-authored, on the application and operation of air conditioning apparatus — thus detailing the practice as well as the theory.

In 1913, the Citizens Telephone Co., Grand Rapids, became the first automatic telephone exchange to be air conditioned. The year saw an early hospital air conditioning job, a premature baby ward in Allegheny General Hospital, Pittsburgh. And one of the earliest ammunition industry installations was made in a time fuse loading room at Bethlehem Steel, South Bethlehem, Pa.

### Early Manufacturers in the Field

Buffalo Forge Co., Carrier's employer through those early years, set up the Carrier Air Conditions Co. of America in 1908 as a subsidiary to handle air conditioning contracts. J. Irvine Lyle, New York manager for Buffalo Forge, who had brought the original Sackett-Wilhelms job to Willis Carrier, was named head of the new company.

In 1915, with the war spreading in Europe, Buffalo Forge decided to consolidate its operations by cutting back on activities in this field. Carrier, Lyle and five close associates with a firm belief in the future of air conditioning struck out on their own, establishing the Carrier Engineering Corp. as an independent company. The other members of this original group of founders were Edmund P. Heckel, L. Logan Lewis, Ernest T. Lyle, Edward T. Murphy and Alfred E. Stacey, Jr. The new company, which subsequently became the Carrier Corp., was an almost immediate success. Carrier served as its president from 1915 to 1930, when he became chairman of the board. Lyle was named president at that time and served until his death in 1942. Two of the founders — Lewis and Stacey — are still active members of the firm. Mr. Heckel is a consulting engineer specializing in air conditioning work, and is a member of HPAC's board of consulting and contributing editors.

The first ASHVE Guide, published in 1922, listed three air conditioning companies, Carrier Engineering, the Atmospheric Conditioning Corp., a subsidiary, and W. L. Fleisher and Co., Inc., which installed B. F. Sturtevant Co. equipment. However, there were other firms, well-known in the industry today, identified with many early installations as contractors or as suppliers of such components as fans, heaters and refrigerating machines. Among them — in addition to Buffalo Forge and York — were American Blower, Vilter, and Frick. Refrigeration for a 1911 blast furnace air dehumidifying system designed by Carrier was supplied by the Carbondale Machine Co., which in 1934 became a part of Worthington Pump and Machinery Corp. — now another important air conditioning manufacturer.

Although comfort, health, and human efficiency had been a primary incentive of many of the early temperature control experiments, air conditioning during the first 20 years of its life was applied mainly to industrial tasks. Of the few comfort installations, the Congress hotel in Chicago air conditioned one of its large dining rooms in 1911. In 1912, what was probably the first residential system was installed in a Minneapolis mansion built by Charles G. Gates, son of John W. "Bet a Million" Gates.

The principal drawback to comfort installations was lack of suitable refrigerants. Those in use at the time were ammonia, which was toxic, and carbon dioxide, which required high pressures and massive equipment. Grauman's theater, Los Angeles — first theater to use the new downdraft bypass system patented by L. Logan Lewis — employed carbon dioxide refrigeration when the system was installed in late 1922.

### Centrifugal Refrigeration in 1922

In that same year, Willis Carrier developed the centrifugal refrigeration machine — one of the great advances in refrigeration since its initial development. This new unit was the first refrigerating machine of any kind to employ a low pressure, relatively nontoxic refrigerant — in the initial machines it was dielene, subsequently methylene chloride or "Carrene 1," and now generally "Freon 11" ("Carrene 2"). The initial machine, built for experimental purposes, was later obtained by the Onondaga Pottery Co., Syracuse, N. Y., where it is still in good operating condition. Of the first four machines to be sold, one went to William F. Schrafft and Sons ,Boston, and three to Stephen

F. Whitman and Sons, Inc., Philadelphia — both candy manufacturers and pioneer users of air conditioning.

### Comfort Air Conditioning Opens Up

But now the comfort field had also opened up wide for the first time. In 1924 three of the early centrifugals were purchased to cool portions of the massive J. L. Hudson department store, Detroit, which is now completely air conditioned with 11 centrifugals. In that same year a similar machine was used for air conditioning systems in the Texan and Iris theaters, Houston. In 1925 the Rivoli, using centrifugal refrigeration, became New York's first air conditioned theater, and also in that year, the new Madison Square Garden obtained three centrifugals to supply refrigeration for both air conditioning and freezing the ice rink. In 1927, an air conditioning system using centrifugals was designed for the Roxy theater, New York, largest in the world at that time with some 6000 seats. In 1928 the 21 story Milam building, San Antonio, employing centrifugal refrigeration, opened for business as what was probably the country's first completely air conditioned skyscraper.

Grauman's (now the Paramount) theater replaced its carbon dioxide machine with a centrifugal in 1928.

### "Freon" Refrigerant Is Developed

A second great advance in refrigeration came in 1930 with the announcement of the development of "Freon 12". This new refrigerant was the tailor-made result of a research project initiated by Charles Kettering of General Motors, and staffed by a team of General Motors and E. I. du Pont de Nemours and Co. scientists, headed by Dr. Thomas Midgley, Jr. and Dr. Albert L. Henne, both of General Motors. "Freon 12" was the first nontoxic, nonflammable refrigerant suitable for small capacity refrigeration as well as for larger systems. The rise of the packaged unit—first developed at about that period—was on its way. Kinetic Chemicals, Inc., now a division of the du Pont company, was set up by the two companies to manufacture the refrigerant commercially.

Other advances and new applications were coming. In 1932 the first Carrier steam ejector refrigeration unit for railway car conditioning systems was installed on the Atchison, Topeka and Santa Fe. At about that time Carrier — investigating the possibilities of "Freon 12" — became interested in a fluid obtained as one step of the process—now known as "Freon 11" or "Carrene 2"—which he patented as a refrigerant for centrifugal compressors. In 1935 the centrifugal was applied for the first time to ammonia condensing, eliminating the need for compressing ammonia—an application which has seen wide service in breweries and meat packing plants.

In 1938 the first conduit system, developed especially for skyscrapers and with its space-saving, small diameter, high pressure conduit air distribution, and permitting individual control of room temperature by occupants, was scheduled for installation in the Marlyn apartments, Washington, D. C. In 1946, the large capacity lithium salt absorption refrigerating machine which uses water as a refrigerant and no compression at all was developed by Carrier Corp.

### Over 3,000,000 Tons Capacity in Use

Willis Carrier died October 7, 1950, a little less than two years before the air conditioning industry celebrates its 50th birthday. But he had lived to see the day when virtually every large multi-story office building and hotel would include air conditioning in its plans, when aggressive merchants would consider it unwise in most cases to open a new department or clothing store or remodel an old one without air conditioning, when hospital air conditioning not only of premature baby wards and operating rooms but also of patients rooms would become a commonplace measure directed at improving the health, safety and recovery rate of patients, when the crack transatlantic vessels of the United States Lines fleet were completely air conditioned, along with thousands of buses and railroad cars and even a substantial number of airliners, when it would be difficult to find a city or town throughout the entire country which did not have its quota of air conditioned theaters, restaurants, banks, bakeries, beauty and barber shops, food, drug, shoe, furniture, variety and other stores, funeral parlors and flower shops. He had lived to see widespread air conditioning as an essential part of processing or efficient production in such diverse industries as textiles, tobacco, pharmaceuticals, chemicals, candy, food processing and storage, printing, photography, precision machinery and optical equipment.

It has been estimated that well over 3,000,000 tons of air conditioning capacity representing a huge total investment was in use in this country in 1951. During the past decade the air conditioning industry has entered its greatest period of growth. Carrier Corp. alone has reported a rise in sales from $14,883,641 in 1941 to $80,935,762 in 1951, with the increase from 1950 to '51 amounting to more than the total figure for 1941. Sales for all air conditioning and refrigeration manufacturers were estimated at nearly two-thirds of a billion dollars in 1950.

Continued substantial growth is indicated for some years to come. One of the big frontiers is the residential market with several manufacturers now producing complete year 'round units for residential use, and a new concept of homes built around air conditioning now spreading throughout the home building industry.

FRONT COVER PHOTO — The first centrifugal refrigerating machine in the manufacturer's shops just after its construction

## REVIEWS FREE WORLD'S NICKEL PRODUCTION

THE FREE WORLD'S production of nickel for the full year of 1951 approximated 295,000,000 lb, an increase of more than 10 percent over 1950, according to a review of the nickel industry by Dr. John F. Thompson, chairman and president of the International Nickel Co. of Canada, Ltd.

Canadian producers, he stated, were responsible for 275,000,000 lb. In 1950, Canada produced 247,000,000 lb of nickel in all forms.

# Power Plant Piping

By Hugh Welshman, Jr.
Manager, Industrial Piping Div.
Grinnell Co., Inc.

**Careful consideration should be given the design, manufacture, fabrication, installation and operation of modern piping systems. Present piping developments add to the necessity for proper engineering interpretation, specialized facilities, rigid inspection and control, and skilled shop and field supervision**

BASIC PROBLEMS involved in the design of a power piping system include (1) selection of pipe sizes to allow reasonable velocities and friction losses; (2) strength of parts to provide flexibility within allowable stress limits; (3) material selection to provide stability under the service temperatures and pressures for the life of the plant; and (4) selection of hangers and supports to prevent additive stresses and the shifting of pipe weight loads to connecting equipment.

Code requirements for piping and the determination of pipe sizes were discussed in the December issue. In January, determination of pipe wall thicknesses, expansion and stresses, piping materials, and cold springing of piping systems were considered. Figs. 1 through 9, and Tables 1 through 4, were presented with these first two parts of this article.

## Welding and Fabricating Details

The scope of piping materials which can be fabricated is practically unlimited; the techniques required for various operations will therefore vary according to the material and its ultimate use.

The application of fusion welding to the fabrication and erection of piping has brought about a new form of construction for high pressure, high temperature services.

From the engineer's assembly drawing, the fabricator prepares detail sketches of each piece. These sketches indicate the intermediate dimensions of component parts, developed lengths of bends, and any other dimensions which will aid the workmen in the shop to interpret the engineer's design requirements.

Allowance for weld spacing is a shop setup problem, and should not be considered in making shop detail sketches. This point is demonstrated in the detail sketch shown as Fig. 10. Dimensions *A* and *B* are required on the assembly drawing. No allowance for weld spacing is included in dimensions *B* or *C*. Dimension *B* includes the ¼ in. raised face on the 8 in., 400 lb welding neck flange.

It is recommended that all welding be performed by the shielded metallic arc process in accordance with qualified welding procedures and by qualified operators.

The American Society of Mechanical Engineers Boiler Construction Code has adopted a standard qualification for welding procedure and welding operators, which is known as Section IX. This standard procedure has also recently been adopted by the American Standards Association Code for Pressure Piping.

Butt welded joints may be prepared in accordance with the details shown in Fig. 11. These details vary with the wall thickness. For pipe sizes 2 in. and smaller, backing rings are not essential when the operators are properly qualified. The choice of ring type is optional for all classes of work; however, it is recommended that selection be limited to flat rings (split or solid) and tapered solid rings. The tapered solid ring is normally limited to the boiler feed discharge and main steam piping having wall thicknesses greater than ½ in. to provide adequate seating. Recent recommendations have required the use of flat split rings of comparable material to the pipe for all systems. By using the flat split ring, Fig. 12, the expense of building up the inside to provide adequate seating for tapered rings is eliminated. Fig. 13 shows how well the flat split type backing ring is adapted to butt welding.

Nozzle connections may be either

of the welded or extruded types. Fig. 14 shows the method of making 90 deg welded nozzles. Wherever possible, 90 deg nozzle connections should be of the extruded type, Fig. 15, because of its increased strength and smooth flow characteristics. All nozzles should be reinforced when required by the codes; the methods of determining the amount of reinforcement are given in the codes.

Fig. 16 shows how ideally suited the extruded type nozzle weld is to the fabrication of headers. The extruded nozzle weld is comprised of the extrusion plus the plain circumferential butt weld.

First preference for other branch connections should be butt welded fittings. Cut-in welded connections should be a second preference only because of the inherent vulnerability to improper fit-up.

### Preheating and Stress Relieving

Probably most pipe welds would be improved by preheating the material before laying the first few beads, but the advantages do not warrant the expense. In the case of welding carbon steels of heavy walls and the alloy steels used in power piping, the precaution of preheating is recommended and, in fact, required by the codes. The alloy steels have a tendency to excessive air-hardening without preheating. Preheating of the alloy steels should be at a temperature of approximately 550 F before any welding is performed. Fig. 17 shows a joint that has been wrapped with coils in preparation for preheating.

In making welded joints in thick-walled materials, contraction stresses are set up during solidification of the

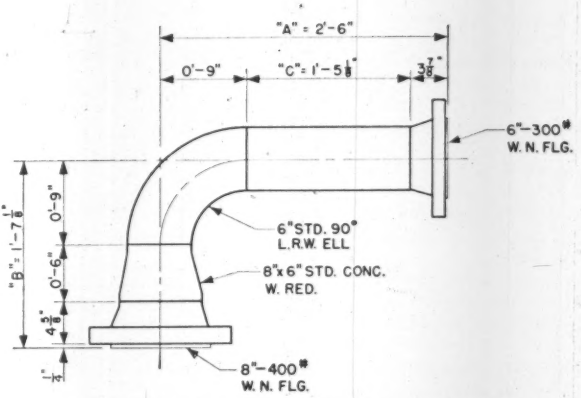



FIG. 10 — DETAILED SHOP SKETCH showing required dimensions. Note absence of weld gap spacing

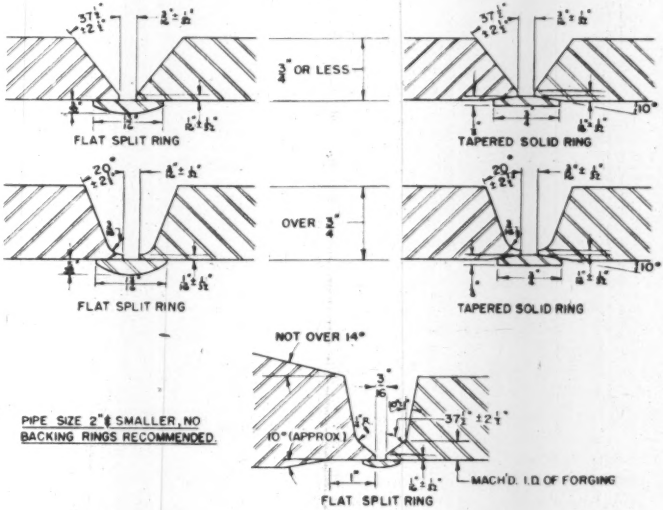



FIG. 11 — BUTT WELDED JOINTS — details of preparation

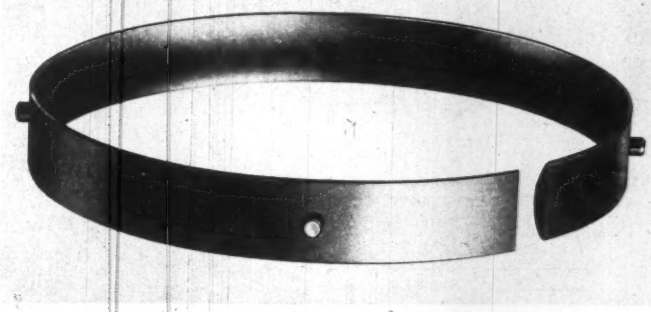


FIG. 12 — BACKING RING of the flat split type

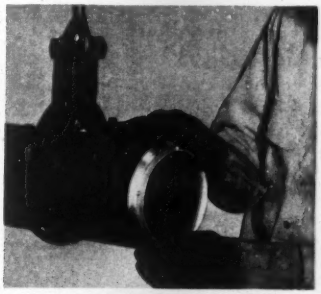


FIG. 13 — THE FLAT SPLIT backing ring is slipped into the beveled end of the pipe until the edge of the land touches the spacer nubs

fused metal. The intensity of such locked-in stresses seems to depend upon the thickness of the parts joined, the ductility of the weld metal, the welding procedure and the rigidity of support during welding.

Locked-in stresses in arc welds can be reduced to satisfactory limits by stress relieving, which also helps to relieve the susceptibility of heat-affected zones in alloy steel welds to graphitization.

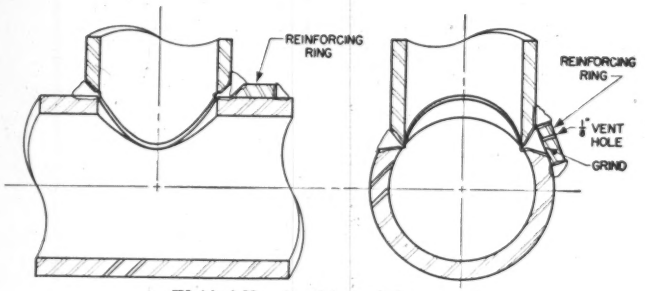
The temperatures for stress relieving of welds range from approximately 1325 F for carbon moly to 1425 F for 2¼ percent chrome, 1 percent moly. Normally, the same coils used for preheating (Fig. 17) are employed in stress relieving. The coils are closed to cover the weld and the temperature is increased to that required for the stress relieving operation. Thermocouples attached to the weld metal are used to determine the pipe temperatures during the stress relieving process. Temperatures are maintained within the limits of plus or minus 25 F for a period of time proportioned on the basis of wall thickness. The material is then allowed to cool at a controlled rate.

Various means are employed for stress relieving welds in the field — by electric induction for pipe sizes 4 in. and over, by electric resistance coils, or by suitable gas burners for sizes under 4 in. In the shop, welds may be stress relieved by any of these methods, or the completed assembly or assemblies may be placed in a heat treating furnace (Fig. 18), with the necessary and proper supports to prevent distortion.

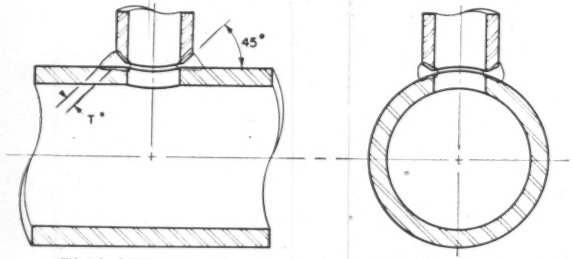
Regardless of the method of heating, a complete temperature record should be made of the heating and time cycles of the stress relieving operation.

## Quality Control of Welded Joints

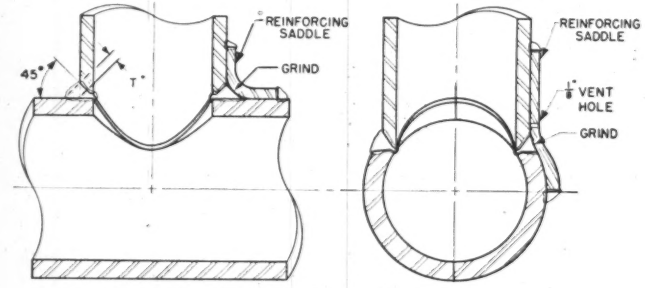
In addition to setting up a welding procedure and qualifying welders in accordance with code requirements, other means of quality control are needed to assure consistently good welds. These methods include the use of X ray examinations, gamma ray inspection by use of radium capsules, paramagnetic powder inspection (such as magna-flux), supersonic testing by use of the reflectoscope, and continual inspection of every step by trained inspectors.




**Welded Nozzle** (Ring reinforcement)
Branch size is greater than one-half of run size.




**Welded Nozzle** Branch size is one-half of run size or less.




**Welded Nozzle** (Saddle reinforcement)
Branch size is greater than one-half of run size.

FIG. 14 — 90 DEG WELDED NOZZLE connections. Fillet reinforcement *T* should be not less than the nominal wall thickness of the branch or header (whichever is smaller) but in no case less than ⅜ in. for 2½ in. branch size or larger

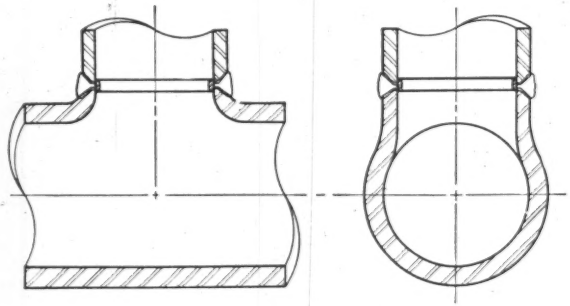
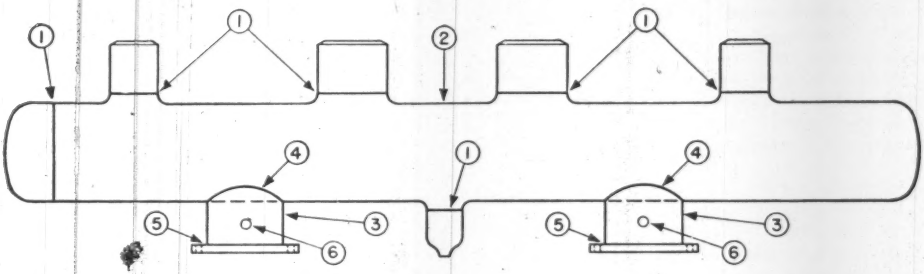


FIG. 15 — AN EXTRUDED nozzle




① All pressure welds are circumferential butt welds with backing rings.
② Header may be seamless tube with caps welded to each end, or turned and bored forging with integral cap one end.
③ Anchor and guide base weldments from pipe of the same material as the header.
④ Strength nozzle weld only, not cut into the header.
⑤ Fillet welds to carbon steel base plates with bolt holes for mechanical attachment to the building structure.
⑥ ¼ inch vent holes in pipe base.

FIG. 16 — HEADER utilizing extruded nozzle welds

To supplement these methods as an occasional spot check, trepanning of the weld can be employed. This method of examination requires the patching of the hole afterward. Trepanning is accomplished by a round plug or boat-shape sample (Fig. 20) being cut up to determine the soundness of the weld by microscopy or physical tests, or by chemical analysis.

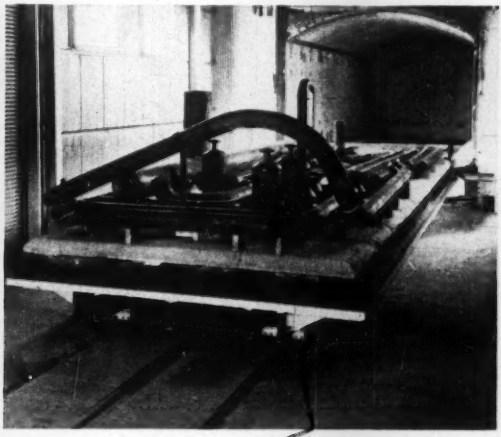
## Pipe Hangers and Supports

In the field of pipe hangers and supports, limitations set by the ASA code are general and do not go beyond the requirement that "supports shall be such as to prevent, in operation, excessive stresses, excessive variation in supporting effort and possible resonance with imposed vibrations". . . . also that "the construction shall be such that complete release of the piping load will be impossible in the case of spring failure or misalignment." The choice of hanger type, the means and methods of attaching the hanger, the arrangement of sway bracing, the procedure (analytical or experimental) in determining the flexibility and the stresses caused by expansion are thus left to the resourcefulness and preference of the piping designer. The requirements for safety are mandatory. They concern the selection of materials suitable for the service, the safety factor to be used in designing the equipment, and certain limitations on minimum dimensions. At present, the ASA code is being rewritten with the hope of incorporating some definite recommendations; generalities are thus giving way to more specific requirements.

A systematic procedure for the design of pipe supports involves (1) the determination of hanger and support locations; (2) the selection and design of the appropriate hanger or support; (3) the locating of guides, anchors or sway braces; and (4) the calculation of hanger and support loads.

The spacing of hangers or supports depends on the weight and size of the pipe, the position of valves and heavy fittings, and the superstructure available for their support. The spacings in Table 5 are the result of practical considerations and in most cases represent much less than the weight-carrying capacity of the pipe. In adopting these recommended spac-

FIG. 17 — JOINT PREPARED for preheating (left) prior to welding . . . . FIG. 18 — STRESS RELIEVING FURNACE (right), showing fabricated piece with necessary supports ready for insertion in furnace



ings, pipe deflections will be unnoticeable, pockets will be avoided and pipe erection facilitated.

Some state codes will not permit spacings as shown in Table 5. For example, some states require a support every 10 ft regardless of pipe size.

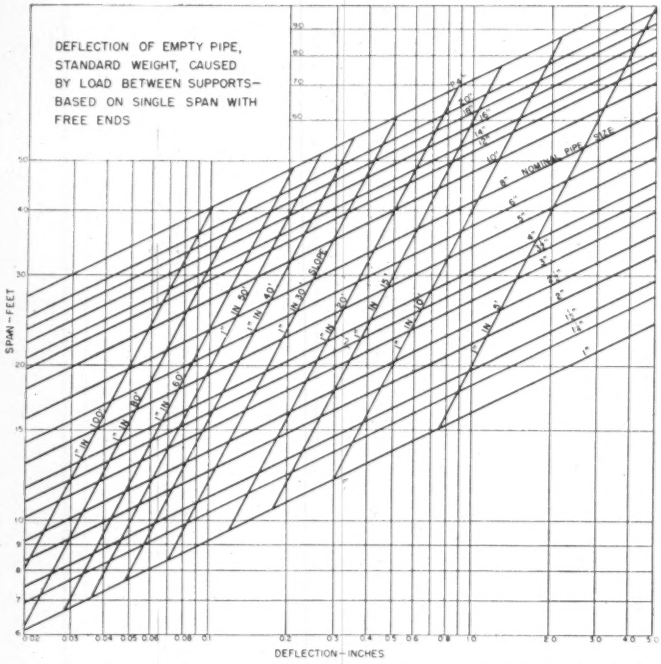
In long horizontal runs, consideration must be given to the proper drainage of the line. Slopes and deflections for these long runs are given in Fig. 21 for empty, standard weight pipe (see note beneath Fig. 21). The bending stress is plotted against span for water filled pipe in Fig. 22.

Hangers should preferably be located at each valve or other concentrated load and near changes of direction. Where overhangs are unavoidable, the stress produced should be determined and appropriately added to the stresses caused by expansion and pressure.

Thermal expansion creates differential movements throughout any piping system, which must be restrained with solid anchors and limiting guides or accommodated with flexible hangers. A system subjected to thermal expansion would usually be analyzed first for stresses (which analysis is made with the assumption that the system has no weight). Therefore, the movement, induced

FIG. 19 — REFLECTOSCOPE being used to check pipe wall thickness

FIG. 20 — BOAT-SHAPED SAMPLE obtained by trepanning for metallurgical and physical testing of welds


DEFLECTION OF EMPTY PIPE, STANDARD WEIGHT, CAUSED BY LOAD BETWEEN SUPPORTS—BASED ON SINGLE SPAN WITH FREE ENDS
SPAN—FEET
DEFLECTION—INCHES
NOMINAL PIPE SIZE

Values are plotted for the pipes being empty since this more nearly approaches the condition that exists for pocketing of condensation to occur in steam, air and gas piping.

FIG. 21

**TABLE 5—SPACING of hangers or supports. (Not permitted in some states —see text)**

| Nominal pipe size, in. | 1 | 1½ | 2 | 2½ | 3 | 3½ | 4 | 5 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum span, ft. | 7 | 9 | 10 | 11 | 12 | 13 | 14 | 16 | 17 | 19 | 22 | 23 | 25 | 27 | 28 | 30 | 32 |

**TABLE 6—EXAMPLE OF USE of Figs. 21 and 22 to determine spacing, slope and bending stress of an outside steam transmission line**

*Given*:
- Length of pipe line ..... 1000 ft
- Maximum difference in elevation ..... 5 ft
  (Maximum slope 1 in. in 16.6 ft)
- Pipe size ..... 10 in. std.
- Maximum allowable bending stress[1] ..... 10,000 psi

*Find*:
Maximum economical spacing for overhead transmission pipe line to provide sufficient drainage with minimum deflection and within allowable bending stress limits.

*Solution*:
- A) From Fig. 21[2]:
  - Maximum span ..... 44 ft
  - Deflection ..... 0.7 in.
  - Bending stress[1] ..... 6800 psi
- B) From Table 5[3]:
  - Span ..... 22 ft
  - Bending stress[1] ..... 1700 psi

[1]Bending stresses are determined from the span-stress graph (Fig. 22). These stresses result from consideration of dead weight only between supports. Bending stresses resulting from thermal expansion must be added in considering combined stresses.

[2]Fig. 21 provides a more detailed analysis primarily for long lines such as outside transmission lines.

[3]Table 5 is based on practical considerations providing a rule-of-thumb solution for general piping systems, such as in a power plant.

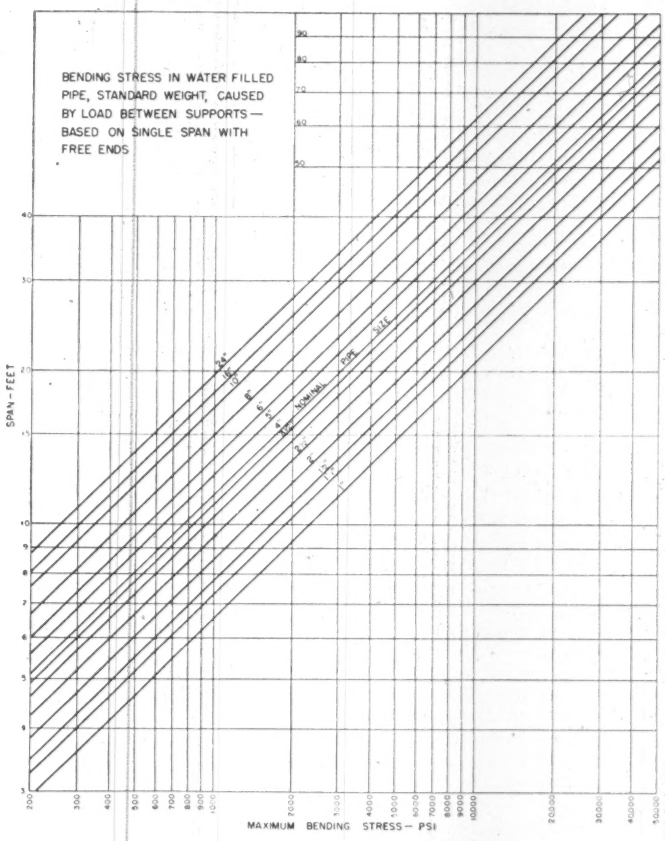

BENDING STRESS IN WATER FILLED PIPE, STANDARD WEIGHT, CAUSED BY LOAD BETWEEN SUPPORTS — BASED ON SINGLE SPAN WITH FREE ENDS
SPAN - FEET
MAXIMUM BENDING STRESS — PSI

FIG. 22

stress and points of restraint have already been determined for the critical points of the system and can be used directly for designing supports. The movements and induced stresses of intermediate points must be modified to account for the flexibility of the piping. The horizontal thermal movements can be accommodated by allowing "swing" or "roll" of the hanger rods. Vertical movements necessitate constant or variable spring supports.

### Spring and Compensating Hangers

The design, fabrication and installation of constant support; variable spring hangers; sway bracings; and vibration dampeners should not constrain the piping (when expansion or contraction occurs) to such an extent as to cause excessive transfer of loads from supports to piping or from support to support. In any case, supports — whether of the rigid or spring type — should be capable of taking the entire piping load imposed by weight transfer, by failure of springs in spring supports, or during erection.

Springs should be provided with means to prevent misalignment, buckling and eccentric loading of the spring, and with stops to prevent excessive spring deflection that would otherwise be the cause of excessive spring stresses.

Hangers employing springs should be provided with means to indicate

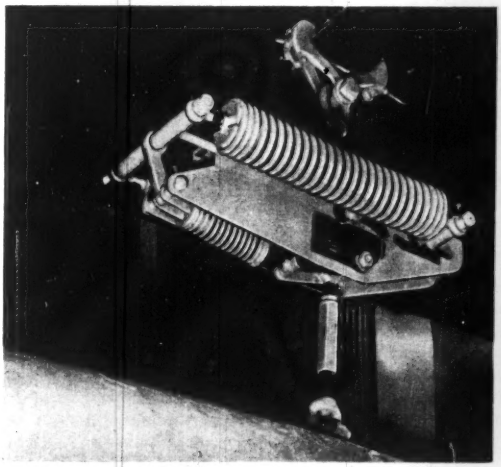


FIG. 23 — CONSTANT SUPPORT type of piping hanger

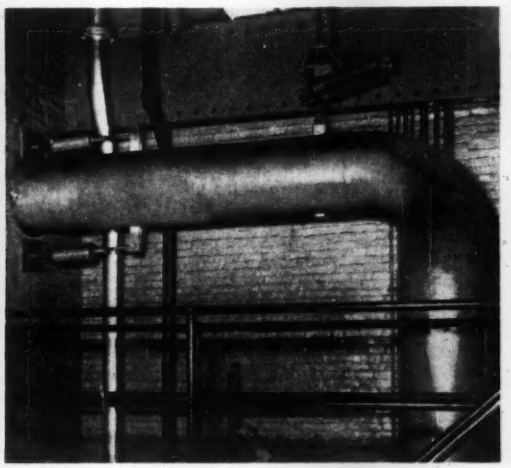


FIG. 24 — SWAY BRACES being used to absorb vibration

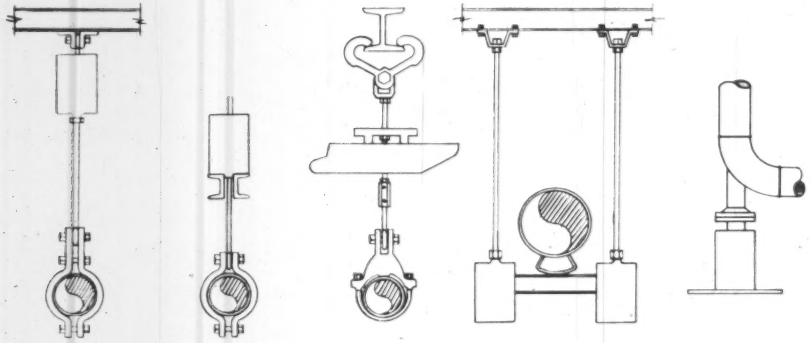

PRE-ENGINEERED VARIABLE SPRING WITH DOUBLE BOLT WROUGHT PIPE CLAMP.
VARIABLE SPRING UNIT OVER SUPPORTING STEEL WITH SINGLE BOLT PIPE CLAMP FOR LOW HEAD ROOM CLEARANCE.
CONSTANT SUPPORT WITH FORGED STEEL BEAM CLAMP AND FORGED ALLOY PIPE CLAMP FOR SERVICE TEMPERATURE UP TO 1050°F.
VARIABLE SPRING UNITS FOR USE ON DOUBLE ROD SUSPENSION.
VARIABLE SPRING UNIT FOR USE UNDER BASE ELBOWS OR FOR UNDERNEATH SUPPORT.

FIG. 25 — TYPICAL hanger assemblies

the proper supporting forces and position of the piping system, except where they are used to cushion against shock or where the operating temperature of the piping system does not exceed 250 F.

Each spring or compensating type hanger or support should be designed to exert a supporting force equal to the load at the point of attachment to the pipe, as determined by weight balance calculations. On high temperature and critical lines where changes in thermal conditions in the piping cause a change in supporting effect of the hanger or support, the excess or deficiency of support should be included in the determination of total stresses in the pipe line.

Where flexibility of the piping system is not desirable, or where there is little or no movement due to thermal expansion, the system may be supported by rigid hangers.

The thermal deflection of piping in modern high pressure and high temperature power stations has made it necessary to specify flexible supports, thereby requiring the designer to give considerable thought to the calculations of hanger loads for the steam pipe lines. Most manufacturers of power station equipment place limitations on the allowable loads at terminal points. Boiler and turbine manufacturers are especially concerned about the pipe weight on their equipment and sometimes specify that the reactions at pipe connections shall be zero. The piping engineer must determine the position of support on a pipe line where the pipe load at the anchor or terminal point is limited.

The size and selection of spring hangers at one time represented a formidable task for most engineers. Very few piping engineers had enough experience in designing a spring. In choosing a spring to support a given load, either the physical height and width of the assembly or the important load deflection rate of the spring might be overlooked, thus causing a considerable weight transfer from one hanger to another or from one hanger to the adjacent equipment.

Most power plant designers recognize the importance of flexible pipe supports and appreciate the economy, the dependability, and the simplicity of selection of commercial spring hangers.

When pipe lines are subject to vertical movements due to thermal expansion of 1 in. or less, variable spring hangers are recommended. These hangers should be designed to support not less than 85 percent or more than 120 percent of the designed load for the total travel between the hot and cold positions.

Where reactive forces at terminal points in a piping system must be kept within specified limits—such as at superheater and reheat outlets and turbine connections—or where the piping is subject to vertical movements in excess of 1 in., the use of constant support type hangers (Fig. 23) designed to provide a substantially uniform supporting force equal to the load throughout the range travel, is recommended.

When necessary to prevent abnormal movement or vibration in pipe lines, sway braces (Fig. 24) or vibration dampeners are used. They should be installed in a manner so as not to interfere with or restrain the piping from normal movement resulting from thermal conditions. Sway braces of the energy-absorbing or instant counterforce acting type are recommended for control of undesirable pipe line movement.

### Hanger Assemblies and Clamps

Other essential components of the hanger assembly are the attachments to the pipe and the building structure. Typical hanger assemblies are shown in Fig. 25.

Since a clamp is in direct contact with the pipe and subjected to operating temperatures, the material selected must be suitable. For temperatures of 850 F and above, alloy steels are recommended for stability. Incidentally, it is advisable to specify pipe clamp materials with chemical compositions comparable to the pipe.

For temperatures from 450 to 850 F, mild steel may be used for the pipe clamp and for service temperatures below 450 F, cast iron, malleable iron or mild steel may be used.

The attachment to the pipe must, of course, be suitable to support the total pipe or equipment load and the design should permit swing or lateral movement of the pipe. At least one part of the complete hanger assembly should have suitable facilities for adjusting the elevation of the pipe

after installation. It is practical to have this adjustment feature a part of the pipe attachment.

When high temperature piping rests on rolls or on a trapeze assembly, it is desirable to use a pipe covering protection saddle in order to keep from crushing the insulation.

Attachment to the building structure may be accomplished in many ways with commercial beam clamps, concrete inserts, brackets fastened overhead and to the side of the structure. In many cases, special attachment of angle clips may be used. The necessary factors for the selection of building attachments depend upon the particular beam or supporting steel, and the ultimate strength of the device must be ample to support the load with a safety factor of at least five in order to comply with code requirements. A safety factor of six or more is necessary in certain states.

It is suggested that the design be such as to permit the load to swing freely and not restrain the normal thermal movement of the system.

Drilling or the welding of lugs to a structural beam is frowned upon in many sections of the country; yet, it is growing in favor and specified by many important engineering concerns.

### Calculating the Piping Supports

Pipe lines should be supported so that the load on the terminal points is not greater than the allowable load throughout the full range of thermal expansion. Therefore, it is desirable to know the supporting force at each pipe suspension point and to have the total supporting forces equal to the calculated weight of the piping system.

With these conditions in mind, it is quite evident that the piping engineer has need for a method of calculating the supports that will be clear, concise and easily understood.

The approach and the assumptions made in solving a hanger load problem could be numerous, depending on the designer. Of the approaches that could be made in the solution of any problem, there will be one solution that produces the best balanced system. Individual loads will very likely be different, but the total of each combination of hanger loads plus reactions obtained should be approximately the same in every case.

A well-balanced suspension system will result in values for the loads on the hangers being in close proximity to one another provided all pipe is of the same size or there are no highly concentrated loads located near a hanger; where there are concentrated loads within a system, the supporting forces required of the adjacent hangers will be correspondingly large.

The first step in the solution of a problem of this kind is to prepare a table of weights.

Calculation of loads is accomplished by taking moments about an unknown value and solving for a second unknown value, or if all loads except one are known, summation of the individual loads will produce the unknown load.

The calculation of loads for hangers of a piping system involves first dividing the system into convenient sections at the following points in the system and the order of preference is as listed: (1) Hangers; (2) bends, whether vertical or horizontal; and (3) risers.

The next step is to isolate each section for study. The solution of each section should be prefaced by the drawing of a free-body diagram. This will provide a clearer picture of the steps involved in the solution.

*[To be continued]*

[Note — This manuscript was presented as a lecture at the Extension School of the University of California. Much of the material is from the Grinnell Co. textbook *Piping Design and Engineering*, published and copyright 1951].

## How To Check Insulation

HEATED lines that are exposed to the weather should be checked to see that they are properly insulated and finished, the Magnesia Insulation Manufacturers Association advises. Otherwise winds, rain, snow, etc., can cause outdoor lines to lose many times the amount of heat that would be lost by indoor piping. In addition to higher fuel costs, excessive heat losses in the case of hot water and condensate lines may result in freezing.

The following points should be noted in making an insulation survey, says the MIMA:

*Are all lines insulated?*—The hot water system may have been extended to an adjoining building, or new steam or condensate lines may have been run outdoors. Check to make sure that all sections of new piping have been insulated.

*Are adequate thicknesses of insulation being used?*—Outdoor lines should be insulated with ½ in. thicker insulation than would be used for indoor lines operating at the same temperature. This rule should also be followed for lines in open areas such as ramps, loading platforms, sidings, yards, etc. If the insulation thickness is found to be inadequate, additional insulation should be applied.

*Is insulation properly protected against the weather?*—Insulation on outdoor lines should be finished, such as with asphalt saturated asbestos roofing felt. Insulation on flanges, fittings and valves should be finished, such as with asphaltic plastic weatherproofing.

*Is the weather protection in good repair?*—Weather resistant jackets should be inspected for holes, torn and loose laps, loose or broken wiring and any other deterioration. Any needed repairs should be made promptly. In the case of weather resistant plastic finish on flanges, fittings and valves, any cracks or dents should be sealed with fresh plastic weatherproofing. Insulation cannot retain its heat saving ability if it becomes waterlogged.

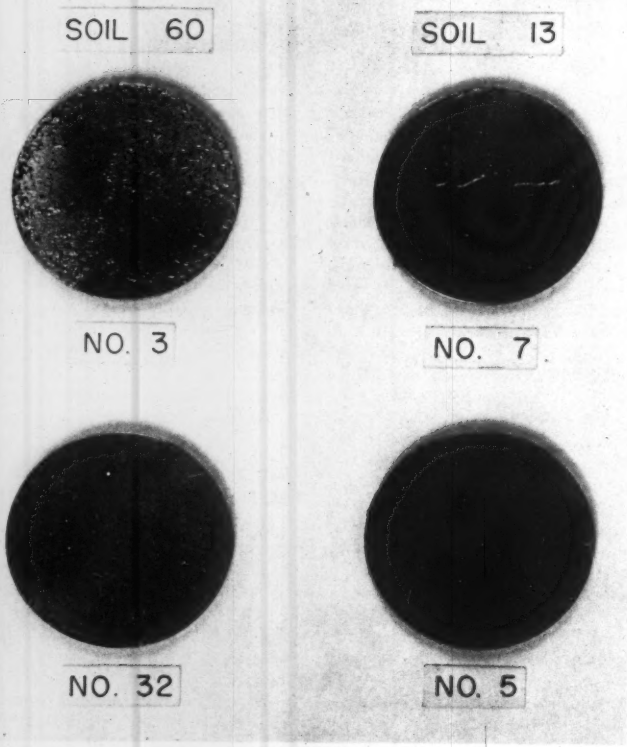
### WHEN WILL NPA RESTRICTIONS BE MODIFIED?

UNCERTAINTY AS TO the National Production Authority's policies with respect to building is discouraging the planning of future construction, A. Naughton Lane, president of the Producers' Council, national organization of building products manufacturers, said recently.

"Much urgently needed commercial, industrial and institutional construction is not being planned because owners are unable to determine at what approximate date NPA expects to be able to modify or remove its restrictions on private construction," Mr. Lane said. "If the greater part of the existing restrictions are to be relaxed within a year or so, architects should now be drawing up plans and specifications."

# Cathodic Protection of Underground Piping

**National Bureau of Standards study provides basis for determining optimum potential to maintain for effective results**




A RECENT NATIONAL Bureau of Standards study provides a scientific basis for the cathodic protection of iron and steel. All four steel specimens were exposed to corrosive soils for 60 days. The upper two (control) specimens received no protection, while the lower two were maintained at a protective potential of –0.77 volt (saturated calomel scale) after 48 hr without protection. Although the control specimens show considerable corrosion, the protected specimens (except for the unprotected period) are virtually undamaged. The two specimens at the left were exposed to a very acid soil (pH 2.9), those at the right to a very alkaline soil (pH 9.5)

UNDERGROUND CORROSION of pipe has been estimated to cost $600 million annually in the United States. Efforts to reduce this toll have been stimulated since 1941 by defense requirements for steel and other metals.

Underground corrosion can be greatly reduced by cathodic protection techniques, in which the structure is maintained at a suitable negative electrical potential.

A recent study[1] by W. J. Schwerdtfeger and O. N. McDorman, of the National Bureau of Standards corrosion laboratory, provides a better understanding of this important method of inhibiting underground corrosion. The study centered around laboratory determination of the optimum potential to be maintained for effective protection. By eliminating uncertainties inherent in field measurements, an optimun protective potential was determined. The value (minus 0.77 volt, referred to a saturated calomel electrode) was confirmed by weight-loss measurements on electrodes maintained at the selected potential in five corrosive soils.

## How Cathodic Protection Works

Normal corrosion of iron and steel underground is largely an electrolytic phenomenon. When iron is exposed to the soil, local differences in electrical potential develop at the surface of the metal, resulting in the formation of numerous small corrosion cells. This means that electric currents flow through the soil from certain areas (anodes) to areas of less negative potential (cathodes), with accompanying loss of metal from the anodes and evolution of

hydrogen at the cathodes. When cathodic protection is applied, direct current from an external source is caused to flow through the soil from an auxiliary anode toward the corroding surface. This applied current causes the cathode potentials to approach the anode potentials, and thus reduces the corrosion currents.

The potential at which an underground structure, such as a piping system, should be maintained in order to inhibit corrosion is important. Insufficient potential gives inadequate protection. Maintaining a greater potential than needed is costly, since this requires supplying a larger external current through the resistive earth.

When the potential of a cathodically protected underground structure is measured, an indefinite *IR* (voltage) drop is ordinarily included. The magnitude of this drop at a given value of current depends upon the conductivity of the soil and the position of the reference electrode used in making the measurement. Corrosion circuits are complex, and there is no general agreement as to where the reference electrode should be located. A measured value of —0.85 volt (referred to a standard copper-copper sulfate electrode) is generally accepted as the optimum protective value. Yet because the amount of *IR* drop is not ordinarily known, identical readings of —0.85 volt obtained at different installations are not likely to indicate the protective potential free of undesired *IR* drop.

These uncertainties were eliminated in the NBS laboratory in arriving at the value of —0.77 volt referred to a saturated calomel electrode. Since this value corresponds approximately to —0.85 volt referred to the copper-copper sulfate electrode, the NBS work confirms the practice of cathodic protection engineers for the special condition when all *IR* drop is eliminated except that which is included in the field of the normal corrosion circuits.

### Determining the Correct Potential

To arrive at the optimum protective potential for steel in soils, the potentials of steel electrodes were measured at the NBS in 20 air-free soils, ranging from very acid (pH 2.9) to very alkaline (pH 9.6). Potentials were plotted against the pH values of the soils. The resulting curve intersected the potential curve for the standard hydrogen electrode at approximately pH 9 and a potential of —0.77 volt (referred to a saturated calomel electrode). This potential was also approximately the most negative value measured. At more negative potentials, iron becomes cathodic to the hydrogen electrode and corrosion therefore ceases.

To confirm the effectiveness of a —0.77 volt protective potential, weighed steel electrodes were exposed to five soils in specially designed corrosion cells. After two days without protective current, the electrodes were maintained at —0.77 volt for 60 days. By making potential measurements with an electronic interrupter in conjunction with a potentiometric measuring circuit, all *IR* drop external to the boundary of the corrosion circuit was eliminated. Weight lost during the test by the electrodes maintained at —0.77 volt was negligible compared with weight losses of control electrodes that received no current. Electrodes allowed to deviate for relatively short periods to potentials less negative than —0.77 volt lost appreciable weight, but electrodes maintained at more negative potentials (—1.0 volt) showed no appreciably greater reduction in weight loss.

### Current Required Is Not Uniform

The current required to maintain a —0.77 volt protective potential is not uniform. With most of the soils tested, the necessary current diminished to a fairly stable value after about three weeks. These minimum values of current needed to maintain the protective potential differed for different soils, and were approximately equal to the average corrosion currents calculated from the weight losses of the unprotected electrodes.

It was possible to estimate the minimum protective current initially required for cathodic protection in a particular soil by preliminary measurements. Electrode potentials were measured as increasing values of current were applied. The potential-current curve given by these measurements has a characteristic change in slope at a certain current value, above which the potential changes more rapidly. The current indicated by the change in slope was taken to be the minimum value initially required for effective protection. This current when constantly applied caused the electrode potential to drift to the protective value (—0.77 volt) in from three to 21 days as alkali accumulated on the electrode surface.

Prior to disassembling the corrosion cells, the protected electrodes were left without protective current for about 15 hr, after which a curve relating potential to applied current was again obtained. This time the change in slope typical of corroding metals was no longer evident. This was taken as a further indication of the effectiveness of the protection against corrosion furnished by the —0.77 volt protective potential.

[1]For further details see Potential and Current Requirements for the Cathodic Protection of Steel in Soils, W. J. Schwerdtfeger and O. N. McDorman, *J. Research NBS*, 47, 104 (1951) RP 2233.

## URGES INTERCONNECTING NATURAL GAS PIPE LINES

A $100 MILLION program of research and development looking to integration of gas distribution facilities and expansion of service to the public was suggested last month by Frederic O. Hess, Philadelphia, past president and a director of the Gas Appliance Manufacturers Association. "As the greatest fuel distribution system ever conceived, gas now influences the life and comfort of 28 million American families and motivates more than 25,000 different industrial processes," he told an executive session of the group.

"Our best thinking should be devoted to a study of ways to integrate the gas supply system and correct some of its growing pains," he said. For example, the various natural gas pipe lines, now comprising a network of 260,000 miles, might be extensively interconnected to provide greater flexibility, particularly when seasonal or other emergency conditions place extra stress on the system. Such interconnection from Kansas City eastward to New England and south to Tennessee, he stated, would benefit the public, the national welfare and industry in general.

# Simplifying the Choice of Cooling and Dehumidifying Equipment

**Melvin A. Ramsey, Contract Engineering Div., Worthington Pump and Machinery Corp., continues his discussion of solving air conditioning problems on the psychrometric chart. An example showing the method is given in some detail, and the appendix presents helpful rules used in the solution**

IF CERTAIN ROOM conditions are to be maintained, the conditioned air must enter the room at a temperature that will rise or fall to the desired room condition while absorbing or giving out the sensible heat to the room at the rate of the actual sensible heat gain or loss. The moisture with the air must be sufficiently less or more than that desired with the room air, so that, in changing to the desired room conditions, the moisture produced in or leaking into the room is absorbed or that leaking out is supplied, at the proper rate to maintain equilibrium at the desired condition.

Thus, if the problem is the common one of cooling and dehumidifying, the air must enter at a temperature less than that desired in the room and the absolute humidity must be the proper amount less than the desired room condition, so that with the particular amount of air entering, both sensible and latent heat gains of the room will be removed at exactly the rate that heat enters or is produced in the room.

To illustrate the method of solution, suppose a room is to be maintained at 75 F dry bulb and 50 percent relative humidity when the outside conditions are 95 F dry bulb and 77 F wet bulb. The sensible heat gain of the space (including power for air circulation, duct heat gain, infiltration, if it exists, and the other usual factors, but no part of the sensible heat from the ventilation air brought in through the conditioner) is 100,000 Btu per hr. The latent heat gain of the space (also without any portion of the heat from the ventilation air brought in through the conditioner) is 20,000 Btu per hr. The total space heat gain is then 120,000 Btu per hr. The quantity of outside air for ventilation is to be 1000 cfm.

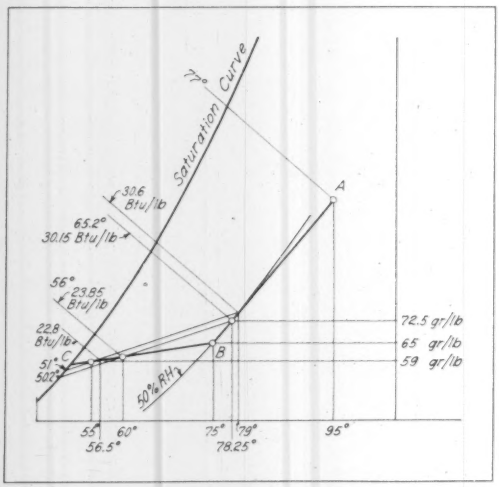



FIG. 4 — SKELETON PSYCH CHART illustrating problem of cooling and dehumidifying explained in the text. A full page psychrometric chart from which this sketch was made appeared in the January article

The total heat from the outside air is then equal to: 1000 × 4.5* (40.55 — 28.2) = 55,700 Btu per hr. (40.55 and 28.2 are the enthalpies, in Btu per lb, of the outside and room air, respectively.) Added to the 120,000 Btu from the space, this gives a total heat to be removed by the coil or washer of 175,700 Btu per hr.

The outside air condition (*A*) and the inside air condition (*B*) are now indicated on the psychrometric chart (Fig. 4) and connected by a straight line. (This line contains all points indicating conditions of mixtures of inside and outside air.)

The line which is the locus of all possible conditions of air which can enter the room and satisfy the particular ratio of latent and sensible heat load in the space is next drawn. In this case, the ratio of latent to sensible of the space is (20,000/100,000) and the grains per lb difference for each degree difference is 1.6† × (20,000/100,000) = 0.32.

If 20 deg is counted to the left from 75 F dry bulb on the chart (Fig. 4), it is necessary to count down 20 × 0.32 or 6.4 grains per lb from about 65 grains per lb, corresponding to the inside condition. This gives a point at 55 F and about 59 grains per lb. A straight line should now be drawn through this point and the point representing the room condition and

*See Item 1 in appendix.
†See Item 4 in appendix.

extended to the saturation curve (*C*). This line is the locus of all possible entering air conditions to the room which will satisfy the particular load.

The next step is to decide how much air is to go through the coil or washer (this may or may not be the same quantity as delivered to the room, depending on whether or not a bypass of recirculated air around the coil or washer is used), the condition at which it leaves and enters the cooling and dehumidifying apparatus, and the average surface temperature and contact factor required to attain the desired result. A little experience makes it probable that one of the best selections will be made the first time, but even if the first try does not give the most desirable selection for a particular problem, this method makes it extremely easy to try several and see the approximate effect almost instantly.

In this case, a first try might assume that the air is to leave the coil at 60 F. A point should be located on the locus of all possible room entering conditions at 60 F, which point gives the condition of the air leaving the coil. The quantity to be circulated is then 100,000 ÷ [1.08** (75 — 60)] = 6170 cfm.

The temperature of the air entering the coil will be 75 + (1000 ÷ 6170) (95 — 75) = 75 + 3.25 = 78.25 deg.

A point should be located on the line *AB*, Fig. 4, at 78.25 F. This represents the condition of the air entering the coil and a straight line should be drawn from this point through the point representing the coil leaving condition and continued to the saturation curve. The point where the saturation curve is intersected is the average surface temperature of the coil or 50.2 F in this case. The contact factor required would be [(78.25 — 60)/(78.25 — 50.2)] = 0.65.

### Checking the Steps So Far

Now is a good time to make an approximate check of the steps taken so far. The solution proposed is that 6170 cfm enter the coil at 78.25 F dry bulb, 65.2 F wet bulb, and 30.15 Btu per lb enthalpy, and leave the coil at 60 F dry bulb, 56 F wet bulb, and 23.85 Btu per lb enthalpy. This represents a heat removal of 6170 × 4.5 (30.15 — 23.85) = 175,000 Btu per hr, which is practically the same as the 175,700 Btu removal that is required, indicating that the past steps have almost certainly been carried out correctly. (A variation of up to 5 percent might be considered sufficiently close and with reasonable care it is unlikely to be over 3 percent.)

The coil for this should have a face velocity and number of rows as required to give a contact factor of 0.65. Reference to Fig. 5 (which is Fig. 1 repeated from the January article) indicates that, with 500 fpm face velocity, the ratio of exterior surface to face area should be about 41.5. This might require more than two rows but less than three rows. If two rows were to be used, the velocity (from Fig. 5) should be about 280 fpm. Such a low velocity is not necessarily bad but it results in a rather expensive coil. The three row coil at 500 fpm would cost less. In most cases, even numbers of rows are used and a four row coil for 500 fpm would probably not cost more than a two row coil for 280. If the four row coil is used at 500 fpm, which is usually considered a reasonable face velocity from the standpoint of economy, not excessive air resistance and no serious carrying of the condensate from the coil into the air stream, the contact factor becomes 0.8 and the face area can be reduced because with that contact factor, the air circulation over the coil can be reduced.

It is now necessary to have a new lower temperature leaving the coil which will result in less circulation through the coil, a higher average surface temperature and a condition of air entering the coil which is nearer the outside air condition. The temperatures must be such that [(temperature entering coil — temperature leaving coil)/(temperature entering coil — average surface temperature)] = approximately 0.8.

To locate a new line indicating the change of conditions of the air as it goes through the coil, so that the

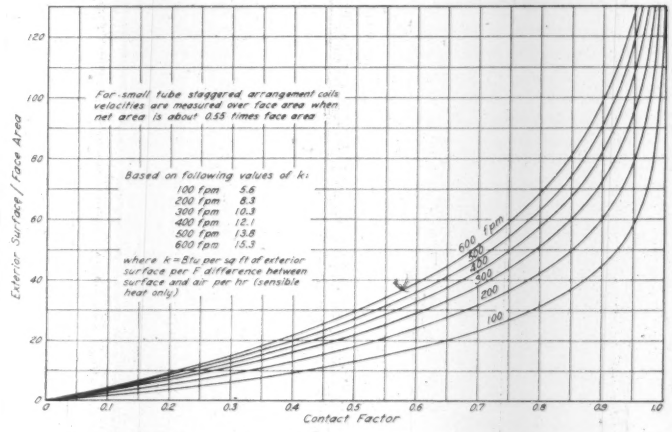

For small tube staggered arrangement coils velocities are measured over face area when net area is about 0.55 times face area
Based on following values of k:
100 fpm 5.6
200 fpm 8.3
300 fpm 10.3
400 fpm 12.1
500 fpm 13.8
600 fpm 15.3
where k = Btu per sq ft of exterior surface per F difference between surface and air per hr (sensible heat only)
Exterior Surface / Face Area
Contact Factor
600 fpm
500
400
300
200
100

FIG. 5 — CONTACT FACTOR chart used in selecting coil for example given in text. This chart was shown as Fig. 1 in the January article, is repeated here for convenience in following through the example

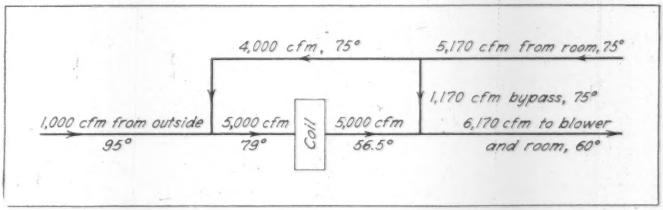



FIG. 6 — BYPASS ARRANGEMENT for the conditioner

**See Item 2 in appendix

entering, leaving and surface temperatures result in a contact factor of 0.8, is not too difficult because all lines indicating the change in conditions of different quantities of air passing through the coil, which fit the heat loads of this problem, are parallel. A straight edge may be moved parallel to the first line showing the change in conditions when passing through the coil, until the distance between the intersection with *AB* and the intersection with *BC*, Fig. 4, is about 0.8 of the distance between the intersection with line *AB* and the intersection with the saturation curve.

It is also usually very simple to approximate the temperature leaving the coil by numerical calculation. It can be seen that the change in the temperature of the air leaving the coil, for different locations of the parallel lines, is rather large compared to a very small change in the average surface temperature and the coil entering temperature. It is easy to see that the average surface temperature won't be far from 51 deg and the coil entering temperature won't be far from 79 deg. (79 — 51) = 28, and 79 — (28 × 0.8) = 56.5 deg.

A second line has been drawn on Fig. 4 parallel to the first one and in such a position that it intersects the locus of all possible room entering conditions at about 56.5 deg. This results in a coil entering temperature of 79 deg and an average surface temperature of 51 deg.

The rate of circulation through the coil is now 100,000/[1.08(75 — 56.5)] = 5000 cfm.

If it is desired to check the 79 deg coil entering temperature, it should be 75 + [(1000/5000)(95 — 75) = 79.

Should it be desired to check the location of this last line on the chart in another way, the total heat removal of the coil will be 5000 × 4.5 (30.6 — 22.8) = 175,000 Btu per hr, which is almost exactly what is required.

The face area required for the coil is 5000/500 = 10 sq ft. The total outside surface should be about 10 × 64 = 640 sq ft.

The 5000 cfm may or may not be the total circulation to the room. If, for any reason it is desirable to use the 6170 cfm entering the room at 60 deg, it is only necessary to arrange the conditioner, as shown in Fig. 6, with a bypass. This could be a permanently set bypass, in which case it would give the same type of results as a conditioner with a coil which changed the 6170 cfm to 60 F dry bulb and 56 F wet bulb. Of course, this bypass could be arranged to permit bypassing larger quantities, and controlled automatically, in which case it would permit the maintenance of better room conditions when the sensible heat from the space is reduced. Means would then be required to avoid too low a coil surface temperature by control of the refrigerating capacity.

*[To be continued]*

## Appendix

### HELPFUL RULES

1) Given a particular cfm which is changed in heat content by a certain Btu per lb, the Btu per hr represented = (cfm/13.4) × 60 × Btu per lb difference. Since the 60 min per hr and 13.4 cu ft per lb appear in all these expressions, where "standard" air is considered, there is an advantage in combining them and using *4.5*, where 4.5 = (60/13.4).

2) In the same manner, if a given cfm is changed in temperature by a certain number of deg F, the Btu per hr represented = (cfm/13.4) × 60 × 0.24 × deg difference. Since the 60 min per hr, 13.4 cu ft per lb and 0.24 specific heat appear always in the range usually used for air conditioning, they may be combined so as to use *1.08*, where 1.08 = (60 × 0.24)/13.4.

3) If a given cfm is changed in moisture content by a certain number of grains per pound, the Btu per hr represented = (cfm/13.4) × 60 × (grains per lb difference /7000) × 1050, where *1050* is the approximate latent heat of evaporation of water at a temperature of between about 32 F and 100 F. Since the 60 min per hr. 13.4 cu ft per lb, 7000 grains per lb and 1050 Btu per lb appear always in the range usually used for air conditioning, they may be combined so as to use *0.67*, where 0.67 = (60 × 1050)/(13.4 × 7000).

4) It is important that the air entering the conditioned area absorb latent and sensible heat in the correct proportion. As a part of the problem, it is desirable to draw a line on the chart indicating a given ratio of latent to sensible heat. Such a line will have a slope represented by a number of grains per lb difference for each deg difference:

cfm × 0.67 × grains per lb difference = Btu per hr latent heat
grains per lb difference = (Btu per hr latent heat)/(cfm × 0.67)
cfm × 1.08 × deg difference = Btu per hr sensible heat
deg difference = (Btu per hr sensible heat)/(cfm × 1.08)
(grains per lb difference/deg difference)
= (Btu per hr latent heat × cfm × 1.08)/(Btu per hr sensible heat × cfm × 0.67)

Since the same air usually performs the function of absorbing both latent and sensible heat from the room, the cfm's in both numerator and denominator are identical and drop out. We then have (grains per lb difference)/deg difference = (Btu per hr latent heat × 1.6)/(Btu per hr sensible heat).

To draw a line indicating a given ratio of latent to sensible heat, it is necessary only to count some number of degrees from the reference point, multiply the ratio of latent to sensible by 1.6 and the number of degrees counted to get the grains per lb corresponding to that number of degrees. If both latent and sensible are positive or both negative, the number of grains per pound is counted in the same sense as the degrees (if degrees were counted in direction of increasing value, grains per lb must be counted in direction of increasing value, or vice versa). If latent is positive and sensible negative or latent negative and sensible positive, the grains per lb must be counted in the opposite sense to the degrees.

# Contractor's Skill Implies Warranty of Installation

A HEATING AND ventilating system may be flawless in itself, yet if it doesn't deliver the requisite results, the seller-installer is responsible and liable to the buyer for such failure, according to a recent court decision.

General Corp. (all names dreamed up) is a general contractor. In such capacity, it was retained by Clyant & Clyant to make alterations and improvements in their quarters at the Whatsit office building. General, having reserved the right to employ subcontractors, ratified the retaining of the Waum Cooley Co. (chosen by Clyant & Clyant) to install a heating and ventilating system.

### Installation's Results Not Satisfactory

Mr. Clyant, in a telephone conversation with Mr. Cooley, said he wanted a heating and ventilating system put in, and that he had a proposition from another contractor, who estimated it would cost $3200 "to have this work performed". Mr. Cooley replied, "If the other contractor could do the job for that sum, there's no reason why my firm can't do it for the same amount." No particular system or details were mentioned.

Without loss of time, Cooley started on the installation. During the work's progress, he billed General Corp. in the amount of $1200, and received General's check therefor (it being promptly reimbursed by Clyant & Clyant). After the installation was completed, Cooley collected the $2000 remainder by similar process — he sent a bill to General, which immediately sent a check to the Waum Cooley Co. General then billed Clyant & Clyant; however, this time Clyant refused to pay the sum demanded, stating that the heating and ventilating unit did not operate properly.

### Job Conditions the Cause

Right here a pivotal circumstance transpired. Clyant telephoned Cooley, complaining that the system installed

by him did not deliver a satisfactory degree of temperature. To which Cooley replied, in effect: "The system itself is all right. Trouble is, there's not enough steam."

When General Corp. sued both Clyant & Clyant and Cooley to recover the sum General had paid out, it appeared from the evidence that the practice at the Whatsit office building was to supply steam intermittently to the radiators. The heat of the radiators carried the necessary temperature in the rooms for half an hour or more after the steam was shut off.

The unit installed by Waum Cooley in the building had radiating fins over which the outside cold air or the returning air from the room was circulated, thereby quickly depriving the surface of its heat. "When the building source of heat was shut off," as the court said in reviewing the evidence, "no more heat could be directed to the rooms . . . until the source of steam was turned on again." In other words, the heating methods in the building were not adapted to the unit installed by the defendant Waum Cooley Co.

The other defendants, Clyant & Clyant, swore that the premises were cold and that they could not use a portion of their quarters during the winter months. Since defendant Cooley claimed that a proper system had been installed by him and hence he was not responsible because there was not sufficient steam to operate it, the judges saw this case as hinging upon the liability of defendant Cooley to defendants Clyant & Clyant. The court reasoned along these lines:

### Buyer Relies on Seller's Knowledge

Waum Cooley has been in the business for the past 35 years. It was his duty to investigate and to ascertain, before a unit was installed, whether it would operate properly under the conditions existing in the building. The law provides that when a buyer, expressly or by implication, makes known to the seller the particular purpose for which the goods are required, and it appears that the buyer *relies on the seller's skill and judgment*, that is an *implied warranty* that the goods should be reasonably fit for the purpose.

In this case, Clyant & Clyant (the buyer) did not specify any particular type of heating and ventilating unit but left that to the discretion of Waum Cooley (the seller). It appears from the evidence that Clyant & Clyant had no knowledge of ventilating and heating systems. The purchaser was ignorant of everything other than "the general function of a heating and ventilating unit and relied upon the skill and judgment of the seller to provide him with heat and ventilation."

The Waum Cooley Co. admitted that sometime in April of the year in question they were ordered by Clyant & Clyant to install in a certain portion of the Whatsit building a heating and ventilating system capable of operating in winter and summer for the provision of adequate heat and ventilation and suitable to the proposed place of installation. Cooley also stated that General Corp.,

[*Concluded on page 104*]

*William Hurd Hillyer, author of this article, is a contributor to a number of banking and financial publications and has written several books on business. A former vice president of the Atlanta Trust Co., his work there gave him a practical legal background.*

# QUESTION OF THE MONTH

## Should We Connect Discharge from Drip Traps This Way?

I WONDER — asked G. B. in his question published in the December HPAC — if it is good practice to connect the discharge from traps on a 125 lb steam main direct to a low pressure condensate return main located underground adjacent to the steam main, as illustrated in the accompanying sketch?

The low pressure condensate return main will be operated at a pressure of from 20 to 30 lb and will be fed by condensate return pumps located in various buildings served by a central heating system.

The following comments are in answer to this question.

### DISCHARGE TRAPS TO LOW PRESSURE STEAM SUPPLY

I WOULD SAY THAT the proposed method of dripping the high pressure steam main would not be considered good practice.

There is no doubt that the condensate from the trap will flow into the condensate return line going back to the boiler house, as the condensate can always be pushed out of the trap by the pressure in the line (125 psig).

Now let us see why the proposed layout is not good practice. Suppose 1 lb of condensate passes through a trap at 340 F. About 0.1 lb of this condensate will flash into steam and the mixture of steam and condensate will occupy about 2400 cu in. Before part of the condensate flashed into steam it occupied only about 31 cu in. This means that what was a pint of water is now about 10 gal of steam-water mixture. In other words the volume increased about 75 times! Condensate return lines selected from ordinary pipe sizing tables will not easily take care of such expansion. In all probability, the flashing steam will pick up slugs of water and slam them against elbows and other fittings. The result will likely rival a national convention of riveters.

The condensate return line will not be full of steam all the way back to the boiler house as the flash steam will eventually condense. The system will then be quiet and behave itself until a high pressure trap opens again.

I would like to suggest that the traps dripping the high pressure steam main be emptied into a low pressure steam line. Since the question says several buildings are served by a central heating system and that the piping is underground, it is likely that a low pressure steam line is in the same tunnel. With the drip traps from the high pressure main discharging into a low pressure main, the system should operate fairly quietly and, in addition, some 90 Btu per lb of condensate will be saved.

The accompanying sketch shows one of the ways this might be connected. Note that the condensate from the low pressure steam main dumps into a line leading to the low pressure receiver.

It might be necessary to provide space for the condensate leaving the high pressure traps to flash into steam instead of connecting directly to a low pressure steam main. More information about the system should be at hand before deciding whether or not a flash tank would be necessary. The amount of condensate handled by each trap affects this decision and the quantity of condensate will be a function of the amount of insulation on the high pressure main, the air temperature surrounding the main, and the spacing of the traps. — F. B. M.

### SPECIAL PRECAUTIONS ARE NEEDED

MY FIRST thought — not well considered — was that it would be perfectly all right to pipe the discharge from the drip traps to the 30 lb pressure return line. Insofar as inverted bucket trap operation is concerned, this is the case. There would be adequate pressure differential across the trap to remove the condensate from the 125 lb pressure line.

I'm very much afraid, however, that unless special precautions are taken, objectionable water hammer would develop.

I assume that both the 125 lb supply line and the 30 lb condensate return line are in the same tunnel. The drain line from the supply line to the return line would be short. The flash steam from the trap discharge would be at a higher temperature than the condensate in the return line. Such flash steam would condense almost instantly when it comes in contact with the water in the return line — result, bad water hammer.

### AIR CURTAIN TO KEEP FLIES OUT

*If you don't have the answer to one of your problems, chances are someone else does — or can be helpful on part of it. That's the purpose of this "idea exchange" in each issue, where questions on heating, piping and air conditioning are asked and answered.*

*You are invited to contribute a question for publication, or an answer to a published question. . Please address your reply to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.*

*Here's a question which has been submitted to us by two different readers recently. Can you help them out?*

"The question involves the installation of fans for keeping flies out of kitchens. The idea is to install a fan above a door, with ducts running down each side and blowing air across the door through nozzles. The theory is that high velocity air would blast off flies and set up a barrier against their entrance through an open doorway.

"Presumably, the advantage of this type of installation would be that the door could be either open or closed and kept at either position at will without danger of flies entering the kitchen."

Two possible methods of getting away from this water hammer occur to me. These are shown on my sketch.

On the discharge side of trap "A" provide a length of finned pipe to condense the flash and cool the condensate. Check valves should be provided on both sides of the finned pipe.

On the discharge side of trap "B", I suggest a surge tank with check valves on both sides of the tank. Such a tank should be large enough to hold several trap discharges. The water at the bottom of the tank would be the first to enter the return line and this water would have a chance to cool below the condensate temperature in the 30 lb line.

Frankly, I have been using my imagination and I can't cite any instances where similar hook-ups have been used. The proof of the pudding would be in the eating.

The above discussion is based on the assumption that the 30 lb return line would always be filled with water which would be moving at relatively low velocity.

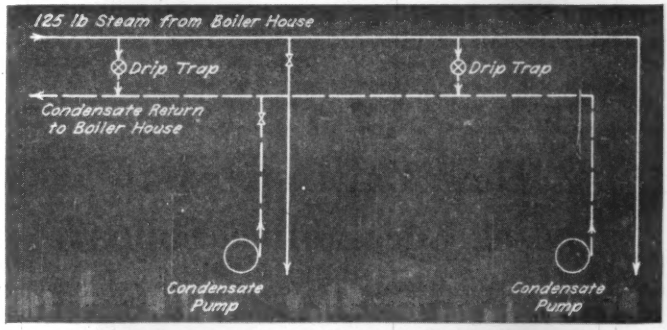
Another thought along this line is that the discharge line from the trap should be as small as practical, but sufficiently long to obtain the desired radiation for condensing flash steam.

— T. H. R.

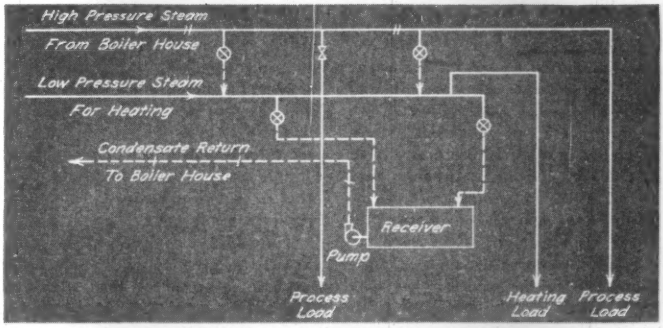
## MIGHT BE A WORTHWHILE IDEA

THIS IS A QUESTION which comes up from time to time, and in the past I have discussed this with some consulting engineers. There are some objections to making this connection — particularly objections based on conditions which may occur. For example, in the event of the steam pressure dropping below the pressure in the condensate return line, then the traps would not discharge. Under the same conditions it is also possible for the condensate to be discharged into the steam main unless check valves are installed in conjunction with the steam traps.

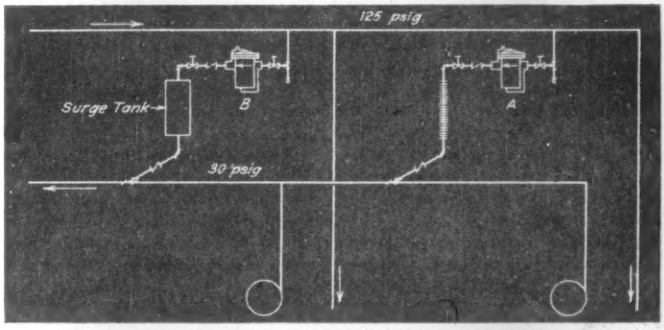
If it is unlikely that the above conditions will exist, then we would not hesitate about recommending the discharging of the traps into the condensate return line. It means a saving in the installation of a separate high pressure return line which would certainly be a worthwhile saving in a large installation. — W. J. G.




IS IT GOOD practice to connect the discharge from drip traps in this manner?




NO — SAYS F.B.M., in ANSWERING the question — and suggests the use of this scheme




PERHAPS O.K. WITH SPECIAL PRECAUTIONS, such as the finned pipe to cool the condensate, and a surge tank, in T.H.R.'s opinion

## DEPENDS ON THE PARTICULAR JOB

THE QUESTION DEPENDS somewhat on the conditions of the particular job.

If the low pressure condensate is from a heating system, the temperature will likely be in the range of 160 to 180 deg.

When the traps discharge into the lower pressure of the condensate line at 20 to 30 psi, about 9 percent of the high temperature condensate will flash into steam. When this steam contacts the cooler condensate in the main condensate line, the steam will quickly condense and cause a violent water hammer.

If, on the other hand, the condensate being pumped is at a temperature close to the temperature of 20 lb steam, the condensation of the flash steam will not be so rapid and the water hammer in the line, if any, should cause little concern.

If considerable expense is involved in installing a separate trap line and some noise from water hammer is not objectionable, the use of continuous discharge traps, such as a float or thermostatic, instead of an intermittent or bucket trap should give satisfactory results with the single condensate line. To be absolutely sure of noiseless operation under all conditions, a separate trap line should be used. — L. G. G.

# How Exhaust from Diesel Locomotive Shops?

THE COMMENTS FROM readers in answer to my problem regarding exhaust of gases from diesel locomotive repair shops — which comments were published in the January HPAC — are appreciated.

We have the following conditions which apparently cannot be altered:

1. The exhaust outlets on 5400 and 6000 hp diesels, both of which we operate, are of different styles and come in different positions (front to rear) on the units, although they are all on the longitudinal center line of the units and extend about 6 in. above the high point of the roof.

2. The operating department in the shops tells us the men will not look after ducts or flexible piping or hoods which are made to fit down over the exhaust outlets on the engines. They insist that the hoods or ducts be clear of the end of exhaust stacks so that at any time they can move the units in the shops along the track without moving hoods.

3. Engines are not only run at idling speeds, when moved back and forth, but after new pistons and rings are installed they are speeded up to full speed and run that way for 15 minutes or more.

It therefore becomes necessary to construct hoods with openings large enough to cover both types of engine exhaust outlets. It is most desirable to direct all exhaust gases from the engines through the roof. If only part of the gases is removed, the balance bounces back from hoods, rolls over sides of engines and drops into the pits under the engines where men are working.

It appears to me that these ducts should be equipped with two-speed motor driven fans — one speed when the engines idle and the high speed when the engines are running full speed. Otherwise, in below-zero weather it would be practically impossible to keep the shops warm without excessive fuel costs.

I agree with the comments that the ducts through the roof should be as straight as possible. I also think the fans installed in these ducts should have the motors outside the gas path, and am wondering whether the propeller type fan would not serve best for these applications.

Recently, the opinion was ventured that the shop should be equipped to bring in 10 cfm of fresh air for each rated horsepower. This would be 15,000 cfm for a 1500 hp unit. All this air would be heated to room temperature upon entry.

The table on page 154 of the January HPAC gives approximately 3 cfm per engine hp at full load. On this basis, the above suggestion recommends three times as much fresh air intake as is used by the engines. We are wondering if there is any reason it should take so much additional air to keep the shop air satisfactory for the workmen.

I hope the above gives a better idea of the problems which we would like to solve.

Referring further to the comments in the January issue on this question, the tabulation of data mentions the heating of the exhaust gases to 850 F. Tests made in our shops show temperatures of 450 to 600 F where gases leave the exhaust pipes of 1500 hp engines running at full load.

Regarding design of exhaust hoods for the outlets, what should the slope of the sides be? How should the proper exhaust fan capacity be determined?

One of the comments discussed the matter as one of odor control only. I wonder, however, if the problem is only that, or if the diesel engine exhaust gases are not detrimental to health as well. I would like to know, also, how the installation and operating costs for adsorbing or oxidizing would compare with straight ventilation and exhaust?— H. J. B.

## THE LAW —

[*Concluded from page* 101]

as general contractor, was advised by him that the order had been placed.

"The sole question arises," said the court, "as to whether or not there is an implied warranty that the heating and ventilating unit would be reasonably fit for the particular purpose intended. The defendant (Cooley) was bound to use the skill, experience and care ordinarily expected by persons engaged in the heating and ventilating business."

Cases were cited by the court to illustrate the point that a product may be free of defect "in and of itself" and still "be subject to the requirements of implied warranty". One such case had to do with a heating system installed in a dwelling house, with resultant lack of sufficient warmth. In another instance, a contractor sued a manufacturer for the purchase price of a conveyor system installed in the defendant's factory, as the system did not work well. A third citation was a state case in which a realty corporation, ordered by the federal government to convert its oil burning equipment to coal burning equipment, bought a certain type of coal, relying upon the dealer's representation that it would be fit for use in "stokers". In all of these cited cases, the products involved were deemed without fault — yet for various reasons the purchaser's requirements were found to be unfulfilled. For this reason, all decisions went to the purchasers.

By the same token, Waum Cooley, the heating and ventilating contractor, lost his case and had to refund the amount he had received.

### What the Experience Should Teach

His experience, let us presume, has taught him (1) to examine carefully *all* the surrounding circumstances of a proposed installation; (2) not to rely, for his deserved compensation, solely upon the merits of his installed equipment as such; (3) not to let his purchasers rely solely upon his knowledge and experience as an expert, but (4) to insist upon agreed specifications in writing, conformable to the job's particular environment.

[Note: While this discussion applies to an actual case, it must be remembered that legal rules vary in different states.]

# SAM LEWIS' PAGE

## Results Depend Upon Heating System's Details

SAMUEL R. LEWIS, consulting mechanical engineer and a member of HPAC's board of consulting and contributing editors, comments informally each month on practical heating, piping and air conditioning problems . . . . . and sometimes on other matters as well

I have a deep appreciation of all-indirect heating using warm air. Anyone familiar with it realizes the remarkable flexibility or "elasticity" of air as the transporter of the heat that means comfort when weather changes are rapid. Under such conditions, warm air heating systems do an excellent job — especially if the supply fan runs continuously, combined with automatic control of the intensity of the fire.

A warm air heating installation is improved if each room, the rooms in each wing, or the rooms on each orientation, can be supplied by a separate duct, such duct having two inlet dampers near the air heating apparatus (whether direct fired or steam heated). One damper takes air at about 130 deg, and the other takes tempered air at about 70 deg. The two dampers are interlocked so that as one opens the other closes. Both are controlled by a thermostat.

I designed a mechanical warm air heating plant for a single-story, long, narrow, building. This heating plant has a number of original and unconventional features.

The air supply ducts for the rather remote departments at the ends of the building are adequate in size, but the center part of the building nearest the source of heat proved — despite the efforts of an electronic outdoor thermostat — to be warm each morning for a considerable time before the end rooms became comfortable. We corrected the trouble by installing separate thermostats in the end departments, each with double dampers in the air supply duct at the supply fan and source of heat, and thus deliver the air supply at the end rooms independently of the conditions for the balance of the building. I have been employing this single duct — double damper — separate thermostat scheme for school building classrooms for 50 years or more.

### Balancing Radiators and Convectors

I have had recent experience with an old thermally circulated hot water system. The boiler originally was fired manually with egg anthracite coal. An electric stoker was installed later to burn small sized bituminous coal, and a centrifugal water circulating pump was also put in. The pump motor responds to a thermostat in a representative room.

This equipment holds the temperature within very close limits except at times when the climate changes radically. The old hot water radiator valves in this plant are of the angle type that do not shut off tightly. These were designed to leak enough, when in a thermally circulating system, to assure frost protection. When the plant was changed to mechanically circulated hot water, a plug cock was installed in each main circuit near the pump. An old 3 in. main, for example, is reduced to 1 in. by a valve.

We learned that it doesn't pay to try to cool down these old radiators by closing the original supply valve at the radiator. The leak is sufficient (and it may be as small in diameter as the lead in my pencil) to prevent any appreciable drop in the temperature of the radiator.

It is almost impossible to adjust the plug type cocks acceptably, or to be assured, once they are adjusted, that some "enemy" will not change them.

I shall hail with joy an equalizing or balancing valve for hot water heat transmitters that has an adjustment of micrometer range, the valve handle of which must be turned many times to produce any appreciable result and the business end of which is lock-shielded by a cap or a plug that demands a special tool for its adjustment.

I had to balance the somewhat recalcitrant hot water flow for a lofty building. The heat transmitters are of finned tubing, encased in recessed steel front cabinets. The cabinets prevented one from feeling, with his hand, the temperature of the tube, and prevented applying a thermometer or thermocouple to the tube. I hail with equal joy the convector that has a hole in its casing through which I can feel its pulse with my thermometer or with my hand!

### SEES IMPROVED COPPER SUPPLY PICTURE

CORNELIUS F. KELLEY, Anaconda Copper Mining Co. chairman, predicted last month that the U. S. copper supply picture "will begin to improve materially during the latter half of 1952".

"We believe that while undoubtedly copper is in critically short supply today in relation to demands of the civilian economy and the additional demands of mobilization and armament, this situation will be relieved by steps that have already been taken and which it is now proposed shall be undertaken to augment the copper supply," he said.

# DATA SHEET

**Correct positions for the back pressure-arm lift method of artificial respiration, recently adopted by the American National Red Cross upon recommendation of the National Research Council, are here illustrated. In this method the victim is placed prone with the elbows bent and with one hand upon the other. The cheek is placed on the hand, with the face turned slightly to one side. The operator kneels on one knee at the head of the victim. . . . . .**

PICTURE NO. 1 — To start the cycle, the operator places his hands on the victim's back so that the thumbs just touch and the heels of the hands are just below a line running between the armpits. . . . .

PICTURE NO. 2 — He then rocks forward slowly, keeping the elbows straight, until his arms are approximately vertical, exerting steady pressure upon the chest. . . . .

PICTURE NO. 3 — Then he rocks backward, slowly sliding his hands to the victim's arms just above the elbows. . . . . .

PICTURE NO. 4 — Continuing to rock backward, he raises the arms until resistance and tension are felt at the victim's shoulder. Then he drops the arms and thus completes a full cycle. The cycles are repeated 12 times per minute, the expansion and compression phases being of equal length, and the release periods of minimum duration.

*Heating, Piping & Air Conditioning*

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

*JOURNAL* *SECTION*

# Physiological Adjustments of Clothed Human Beings to Sudden Change in Environment—First Hot Moist and Later Comfortable Conditions

By Ford K. Hick, M.D.*, Tohru Inouye†, Robert W. Keeton, M.D.**, Nathaniel Glickman††, Chicago, and Maurice K. Fahnestock***, Urbana, Ill.

This paper is the result of research sponsored by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and by the United States Public Health Service in cooperation with the University of Illinois, College of Medicine, Chicago, Ill.

**SUMMARY — The physiological responses of 7 healthy men dressed in standard summer clothing were compared with those of 10 healthy young men dressed in long-length union suits when they were subjected to sudden changes in environment.**

**On exposure to a hot humid environment, the subjects perspired freely such that at the end of the first hour the moisture content averaged 490 and 200 grams for the summer clothing and union suit groups, respectively; at the end of the second hour 910 and 390 grams for the respective groups. The rectal temperature rose about 0.4 F in the first hour for both groups; it rose 0.4 F more in the summer clothing group by the end of the second hour.**

**On moving from the hot moist to the comfortable environment, all subjects felt cool. The skin cooling was less rapid with the subjects wearing summer clothing. The adjustments and evaporation during the hour after heat exposure are compared.**

THE PAST studies have defined the physiological changes induced in normal young men dressed in cotton union suits who were suddenly exposed to radically different atmospheric environments[1,2]. The subjects were dressed in union suits for simplification of the experiments and accuracy of measuring skin temperature. The necessary physiological adjustments were made readily and without evidence of strain. The experiments were extended to cover subjects with various degrees of cardio-vascular impairment[3]. These cardiac patients also withstood the stresses imposed readily and without evidence of physiologic strain.

The present experiments have used normal subjects dressed in summer weight clothing and will make it possible to compare the physiologic changes induced in a subject in one layer of clothing (union suit) with those in multiple layers of clothing (summer weight clothing). In the experiments, subjects were exposed suddenly to a hot humid environment in which there were no air currents and in which the temperature of the air and walls was maintained at 98.5 F with a 66 percent relative

*Professor of Medicine, Department of Medicine, University of Illinois.
†Research Assistant, Department of Medicine, University of Illinois. Member of ASHVE.
**Professor of Medicine, Emeritus, Department of Medicine, University of Illinois. Member of ASHVE.
††Member of ASHVE.
***Research Professor of Mechanical Engineering, Department of Mechanical Engineering, University of Illinois. Member of ASHVE.
Presented at the 58th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, St. Louis, Mo., January 1952.

[1]Exponent numerals refer to References.

humidity. After completion of the experimental period of one or two hours they were returned for a period of one hour to a comfortable room maintained at 76 F with either 30 or 80 percent relative humidity.

During the stay in the hot room the sweat accumulated in the various layers of the clothing; water was evaporated from the surfaces. All the heat was necessarily lost by vaporization. When the subjects were returned to the comfortable room they were encased in sweat laden clothing from which vaporization was accelerated by the reduced moisture content of the air.

These studies define, under experimental conditions, the physiologic experiences of people dressed in summer clothing leaving and entering air-conditioned spaces in the summer time.

## Subjects and Clothing

Healthy young men whose physical measurements are given in Table 1 participated in the experiments. The experiments were divided into two groups differing only in the amount and type of clothing worn by the men. In one group the men wore long length, 90 percent cotton with 10 percent wool, knitted union suits, designated US, and wooden sandals; in the comparative group they wore a summer clothing assembly, designated Scl, consisting of a two-piece tropical worsted wool suit (Fig. 1), cotton shirt, socks, belt, tie, shoes, and a short length light weight cotton underwear (Fig. 2) which carried the thermocouples. The weight of the clothing alone, *i.e.*, exclusive of thermocouples, wooden sandals, shoes or belt, was approximately 3 lb 9 oz for the summer clothing assembly and 1 lb for the union suit, respectively, in an atmosphere of 76 F with a relative humidity of 30 percent.

Observations, environmental conditions, procedure and method of statistical analysis of data have been previously detailed[1].

## Heat Exposure

Immediately upon exposure to the hot environment, the heat regulatory mechanisms were activated and made adjustments to the new environment,

**Table 1 — Physical Measurements of Subjects**

| Subject | Group[a] | Age | Weight | Height | Area |
|---|---|---|---|---|---|
| | | Years | Lb | In. | Sq Ft |
| C.A. | us | 29 | 174 | 67 | 20.5 |
| J.B. | us | 23 | 139 | 71½ | 19.5 |
| M.B. | us | 19 | 130 | 69½ | 18.4 |
| B.F. | us | 23 | 152 | 65½ | 18.9 |
| E.M. | us | 22 | 150 | 73½ | 20.6 |
| W.P. | us | 23 | 167 | 68 | 20.3 |
| J.S. | us | 20 | 134 | 72 | 20.5 |
| T.B. | us scl | 25 | 161 | 71 | 20.7 |
| B.K. | us scl | 24 | 139 | 69 | 18.8 |
| E.K. | us scl | 23 | 189 | 72 | 22.6 |
| J.K. | scl | 22 | 180 | 70 | 21.4 |
| D.S. | scl | 21 | 165 | 71½ | 20.5 |
| R.S. | scl | 21 | 167 | 73 | 21.1 |
| R.W. | scl | 21 | 141 | 68½ | 18.8 |
| Average | scl | 22.4 | 163 | 70½ | 20.5 |
| | us | 23.1 | 153 | 70 | 20.0 |

[a]US indicates subjects participated in experiments wearing union suits. [b] Scl indicates subjects participated in experiments wearing the summer clothing assembly.

as evidenced by a sharp rise in mean skin temperature, with the subsequent onset of visible perspiration (Fig. 3).

The magnitude of the increase in mean skin temperature in the first 10 min was related to the environmental conditions of the previous exposure as shown in Table 2. When the heat exposure was preceded by a dry environment (30 percent relative humidity), the mean skin temperature rose 4.5 and 3.4 deg in 10 min for men dressed in the union suit and summer clothing, respectively. When the previous environment was humid (80 percent relative humidity), the increases were 3.8 and 2.7 deg, respectively. The 1.1 deg lesser increments of changes in skin temperatures, the differences of which are statistically significant ($P<0.001$), are attributed to the greater insulation offered by the summer clothing assembly and to the large mass (Scl) to be heated.

The influences of relative humidity of the previous environment continue to be evident during the course of the heat exposure. After leaving a dry environment the skin surface temperatures in the hot room, for subjects wearing more insulation, rose to levels of 0.9 deg higher at the end of an hour. This difference

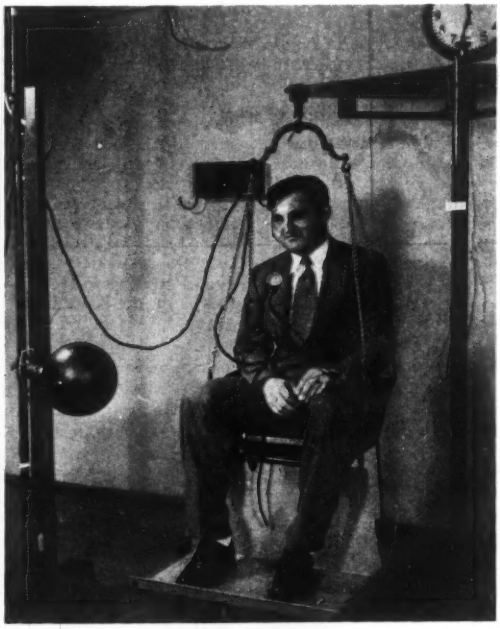


Fig. 1 — Subject wearing summer clothing assembly and seated in a Troemner Balance

Fig. 2 — Cotton underwear of summer clothing assembly showing the thermocouples sewn into the material

increased to 1.4 deg by the end of the second hour. When the previous environment was humid, the skin temperatures, which did not appear to be different at the end of one hour, were higher with summer clothing by 0.7 deg over the union suit at the end of the second hour.

The rectal temperature response on entering the hot environment was identical in subjects wearing both types of clothing[1,2,3]. There was the customary initial decrement of 0.14 deg which occurred within 10 min (Fig. 3). The subsequent course of the rectal temperature was similar for the hour; however, at the end of two hours, the rectal temperature had attained levels of 0.41 deg higher in men wearing the summer clothing assembly than those with the union suit.

The subjects dressed in summer clothing showed visible perspiration on the forehead in about 4.6 min after entrance to the heated room following exposure to a dry environment. Sweating appeared about 6 min later in men wearing union suits. No differences in the time of onset of visible perspiration could be found when the previous exposure was humid.

The rate of heat loss by vaporization during the first hour in the hot room was 0.52 and 0.37 Calorie per (min) (sqm) for men wearing union suit and summer clothing, respectively, if these men were previously exposed to a dry atmosphere; the rates were 0.50 and 0.38 Calorie per (min) (sqm) respectively, when the previous environment was humid. During the second hour in the hot humid room, the evaporative rates were not affected by the added clothing.

Although additional clothing led to measurable differences, the subjective thermal sensations of the men entering the hot room were the same whether they were dressed in union suit or summer clothing. Moreover, the subjective thermal sensations during the one and two hours exposure continued the same regardless of the differences in clothing.

Table 3 — Evaporative Heat Loss After Heat Exposure

| Relative Humidity | Available Moisture at 5 min | | Rate of Evaporation during 5-60 min | | Rate of Evaporation 5-60 min per $\phi$ per $m^2$ [b] | |
|---|---|---|---|---|---|---|
| | US | Scl | US | Scl | US | Scl |
| percent | grams | | Calorie/min/$m^2$ | | Calorie/min/$m^2/\phi$ | |
| 1 Hour Heat Exposure | | | | | | |
| 30 | 170 | 510[a] | 0.71 | 0.80 | 0.0046 | 0.0017[a] |
| 80 | 230 | 470[a] | 0.66 | 0.56 | 0.0031 | 0.0012[a] |
| 2 Hour Heat Exposure | | | | | | |
| 30 | 380 | 870[a] | 1.00 | 1.22 | 0.0028 | 0.0014[a] |
| 80 | 400 | 950[a] | 0.79 | 0.84 | 0.0022 | 0.0009[a] |

[a]Differences between averages of union suit and summer clothing groups are statistically significant.

[b]Rate of evaporation 5-60 min per $\phi$ per $m^2$ represents the rate of evaporative heat loss per minute per square meter per *gram of available moisture*, designated by $\phi$, 5 min after leaving the hot room.

The rate of evaporative heat loss of men wearing union suits in an environment of 76 F with either 30 or 80 percent relative humidity was 0.28 Calorie per (min) (sqm). When the men were dressed in summer clothing assembly, the rate was 0.30 Calorie per (min) (sqm).

## After Heat Exposure

The physiological adjustments imposed by the sudden return to a comfortable environment from a hot room were affected by the insulation offered by the clothing and the moisture it contained.

The amount of moisture found in the clothing five minutes after leaving the hot room was greater for the two hours than for the one hour heat exposure and also greater with the added insulation. The amounts averaged 490 and 200 grams for the summer clothing and union suit, respectively, after a one hour stay in the heat; 910 and 390 grams, respectively, after a two-hour stay in the heat (Table 3).

The succeeding observations are governed by the quantity of water trapped in the clothing. The heat loss by vaporization occurring over a period of from five minutes after leaving the hot room to the end of the hour was the same regardless of

Table 2 — Mean Skin Temperatures or Temperature Change (F) for Union Suit and Summer Clothing Groups

| Time of Observation of Skin Temperatures | 30 percent Relative Humidity | | | | 80 percent Relative Humidity | | | |
|---|---|---|---|---|---|---|---|---|
| | Union suit | | Summer Cloth. | | Union suit | | Summer Cloth. | |
| | Hours of Hot Room Exposure | | | | Hours of Hot Room Exposure | | | |
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| Before leaving Comfortable Room | 92.1 | | 93.3[a] | | 92.5 | | 93.2[a] | |
| After entry to Hot Room | | | | | | | | |
| < 10 min (rise) | 4.5 | | 3.4[a] | | 3.8 | | 2.7[a] | |
| 60 min (temp) | 96.8 | | 97.7[a] | | 97.2 | | 97.2[a] | |
| 120 min (temp) | — 97.2 | | — 98.6[a] | | — 97.2 | | — 97.9[a] | |
| After return to Comfortable Room | | | | | | | | |
| < 10 min (drop) | 6.3 | 6.8 | 4.5[a] | 4.0[a] | 4.7 | 5.0[a] | 3.2 | 2.7[a] |
| < 10 — 20 min (drop) | 0.7 | 1.4 | 1.0 | 1.4 | 0.7 | 1.1 | 0.7 | 1.3 |
| < 20 — 60 min (drop) | 0.2 | 2.3 | 1.6 | 1.6 | 0.9 | 1.8 | 1.8 | 2.0 |
| 60 min (temp) | 89.6 | 86.7 | 90.6 | 91.6 | 90.9 | 89.3 | 91.5 | 91.9 |

[a]Differences are statistically significant between averages of union suit and summer clothing groups for the corresponding conditions.

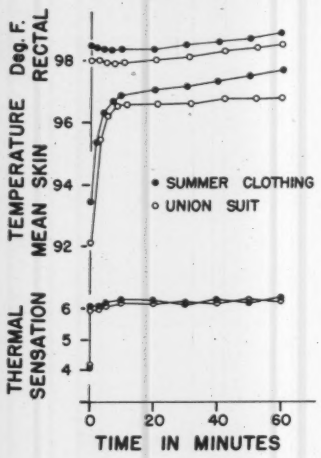



Fig. 3 — Changes in mean skin and rectal temperatures and thermal sensations of men dressed in summer clothing and union suits during an hour in a hot room after having been exposed to a dry comfortable room

the types of clothing compared. The average rates of evaporative heat loss during the 55 minute period regardless of the relative humidity of the environment were 0.68 and 1.03 Calorie per (min) (sqm) after one and two hours heat exposure, respectively, for the men wearing summer clothing. This is in contrast to 0.28 Calorie per (min) (sqm) which the men lost dressed in the same summer clothing while seated in a comfortable room prior to heat exposure. On the basis of the amount of available moisture, there is less vaporization per gram of water when the men were dressed in the summer clothing than in the union suit. The differences were 0.0021 and 0.0016 Calorie per (min) (sqm) (*gram of available moisture*) in the dry and humid environments, respectively.

The course of the body surface cooling was less abrupt upon leaving the hot room when the subjects wore the summer clothing (Fig. 4). The decrements of mean skin temperature in 10 min after a one and two hour heat exposure were 1.8 and 2.8 deg, respectively, less when the men wore summer clothing and were in an environment of 30 percent relative humidity; the differences were 1.5 and 2.3 deg, respectively, when the cooling proceeded in an environment which was humid (Table 2). These effects of added clothing were statistically significant. As in previous studies with the men dressed in union suits, the skin temperature decrements in 10 min were statistically significantly larger in the dry than in the humid environments.

Skin cooling was routinely followed for 60 min in the comfortable room after the heat exposure. The mean skin temperatures fell at first rapidly then more slowly throughout the hour. The only exception was in the group wearing union suits and with an hour of heat exposure averaging 170 grams of water trapped in the clothing and returning to an environment of 76 F with a relative humidity of 30 percent. This exception showed cooling complete in 20 minutes and the mean skin temperature stationary for the remainder of the hour.

The effects of added clothing were not reflected in any differences in the rectal temperatures. Immediately on leaving the hot room, the rectal temperature increased 0.17 deg and thereafter decreased gradually.

Thermal sensations on entering the comfortable room were the same whether the men were dressed in summer clothing or in union suits. They all felt cool regardless of the clothing, the amount of water it contained and the humidity of the environment. The initial coolness was followed by a feeling of less coolness during the hour.

## Conclusions

On exposure to a hot humid environment, the subjects perspired freely so that at the end of the first hour the moisture content averaged 490 and 200 grams for the summer clothing and union suit groups, respectively; at the end of the second hour 910 and 390 grams for the respective groups. The rectal and skin temperatures attained slightly higher levels with the added clothing by the end of two hours.

On moving from the hot room to the comfortable environment, all subjects felt cool. The skin cooling was less rapid with the added insulation in spite of the greater amount of moisture it contained. The amount of evaporation during the hour was the same regardless of the clothing.

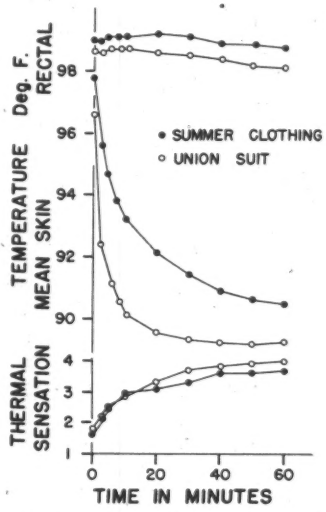



Fig. 4 — Changes in mean skin and rectal temperatures and thermal sensations of men dressed in summer clothing and union suits in a dry comfortable environment after having been exposed to a hot moist environment for 1 hour

The men dressed in standard summer clothing withstood the sudden changes in environment readily and without evidences of strain. The adjustments were made with as much ease as by those men dressed in union suits.

## References

1. Physiological Adjustments of Human Beings to Sudden Changes in Environment, by N. Glickman, T. Inouye, S. E. Telser, R. W. Keeton, F. K. Hick and M. K. Fahnestock (ASHVE TRANSACTIONS, Vol. 53, 1947, pp. 327-356.)

2. ASHVE RESEARCH REPORT No. 1342 — Comparison of Physiological Adjustments of Human Beings During Summer and Winter, by N. Glickman, T. Inouye, R. W. Keeton and M. K. Fahnestock (ASHVE TRANSACTIONS, Vol. 54, 1948, p. 307.)

3. Physiological Adjustment of Normal Subjects and Cardiac Patients to Sudden Change in Environment, by N. Glickman, T. Inouye, R. W. Keeton, I. R. Callen, F. K. Hick and M. K. Fahnestock. (ASHVE JOURNAL SECTION, *Heating, Piping and Air Conditioning*, February, 1949.)

# Cooling Water System for the Arnold Engineering Development Center

By John H. Carter,* St. Louis, Mo.

**SUMMARY — A highly important consideration in the construction of the Arnold Engineering Development Center, built for the Air Force for testing jet engines, was the furnishing of cooling water facilities. There are three major units of the Center requiring cooling water, the engine testing facility, the gas dynamics facility, and the propulsion wind tunnel.**

**Initially the approximate water requirements of the center had to be established after which a complete water supply system was built. This included a dam, reservoirs, pumping equipment, pipe lines, and a return water system with oil separating arrangements. The initial capacity of this system is 150,000 gpm, with eventual expansion to 450,000 gpm.**

THE ARNOLD Engineering Development Center, now under construction by the United States Air Force near Tullahoma, Tenn., will consist initially of the three major technical facilities described, together with necessary supporting installations and utilities. Other technical facilities will be added in a phased expansion program over a period of years as requirements dictate and as appropriations become available.

The location of the Center is shown in Fig. 1. Fig. 2 shows the layout of the major features of the initial phase of the Center.

Of the supporting installations, the cooling water system is among the most complex, costly and important. In order properly to describe its applications and the engineering design involved, it is necessary to describe briefly the technical facilities and other principal applications of cooling water. Costs and design details of the technical facilities are classified.

## Engine Test Facility

The engine test facility will be the first of the main technical facilities to be placed in operation at the Center. Its primary function is to test turbo-jet and ram-jet power plants under simulated conditions of supersonic speeds and high altitudes, with the engines mounted within the air stream, and also with the air stream ducted into the engine air intakes.

This facility will be capable of testing any jet engine now in service or under development.

Atmospheric air will be compressed by four compressors up to pressures over 40 psia, at rates of flow beyond 250 lb of air per second. The air will be dried by refrigeration to a moisture content less than 1½ grains per pound. It will then be controllably re-expanded through turbines which are mounted on the same shafts as the compressors. After this re-expansion, the air will be tempered by heat exchangers to provide supply air to the engines at any desired temperature between —120 F and 650 F. Metering and bypass valves in the supply air ducting will permit the test operator to supply conditioned air to the test chambers at pressures and temperatures which are accurately controlled.

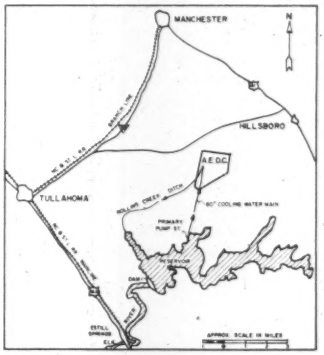



Fig. 1—Vicinity map

Three test chambers and one test bed will be provided. The test chambers are 12 ft 6 in. inside diameter, and may be of any required length up to about 90 ft maximum by the assembly of suitable spool sections.

Exhaust products from the engines under test will pass through a diffuser to discharge directly to atmosphere through stacks, or will discharge through an exhauster-compressor system to atmosphere. To prevent injury to these exhausters and to improve the operating economy of the facility, the exhaust gases will be cooled by direct water sprays and then by shell-and-tube exchangers for further cooling and dehumidification. The altitude exhaust pressure obtainable in this facility will be about 0.5 psia minimum, controllable by the use of valves downstream from the exhaust gas coolers and also by various series and parallel combinations of the six exhauster compressors.

This facility requires approximately 75,000 hp maximum demand, which will increase to about 150,000 hp when a ram-jet addition is placed in service in combination with the engine test facility. Supply air flows will then total about 500 lb per second, at pressures of over 100 psia. Exhauster compressors will also be added to handle the increased flows at pressures which simulate high altitudes. The air supplied to the ram-jet test chambers will be at about 1200 F maximum temperature. This facility will be capable of testing very large ram-jet engines over a wide range of flight Mach numbers and simulated altitudes.

Cooling water is required to re-

*Project Engineer, Sverdrup & Parcel, Inc. Member of ASHVE.

move heat from the following sources: (1) The energy imparted from compressor and exhauster drives, — 150,000 hp for the entire facility; (2) Condensing for about 4500 tons of refrigeration; (3) Oil-fired heaters for the supply air; (4) Test fuels burned in power plants operating under altitude tests. The extreme condition will be two flows of 300 gpm each, of gasoline, kerosene, or jet-propulsion fuels; (5) Air conditioning for control rooms and offices.

The engine test facility alone will have a maximum cooling water requirement of about 50,000 gpm. With the ram-jet addition in operation, the total requirement will be about 130,000 gpm. Large quantities of cooling water will be used in sprays to cool exhaust jet streams of 3000 F or more.

### Gas Dynamics Facility

The second principal test unit to be placed in operation will be the gas dynamics facility. This is a supersonic and hypersonic wind tunnel group designed for aerodynamic testing of aircraft and missiles. The Mach number range of this facility is extremely wide; it extends from Mach = 1.2 up to a value well above Mach = 5.0.* This range is combined with a wide Reynolds' number range, having a maximum Reynolds' number considerably greater than has been available up to the present for aerodynamic development in supersonic wind tunnels. This has been done partly by using test sections larger than those currently in operation, but mainly by the economical and convenient method of increasing the pressure of the air in the tunnel at high Mach numbers. In this way, essentially full-scale Reynolds' numbers of typical missiles in flight are provided by this facility over most of the Mach number range.

The facility consists of an extremely flexible compressor system driven by electric motors of about 90,000 hp maximum demand; two large test sections, each equipped with a flexible throat; heat exchangers; and air driers. The flexibility of the compressor system will make it possible to augment the initial layout by adding more test sections which are planned for the future.

There are 12 compressors in eight series stages, all driven by synchronous motors. The higher stages are unique in centrifugal compressor design; the air from the last stage of compression has a density approaching one-fourth that of water.

High temperatures will be encountered at high Mach numbers. The extremely constricted throat necessary at high Mach numbers will expand the air to as low as 1/250th of an atmosphere absolute. If the air were at room temperature before such expansion, its temperature would fall to within a very few degrees of absolute zero, well below the liquefaction temperatures of oxygen and nitrogen. Heating before expansion is therefore necessary to prevent the formation of liquid air in the test sections.

Cooling water is required to remove heat from the following sources: (1) The total drive energy of 90,000 hp maximum; (2) The oil-fired heaters for the air in the tunnels; (3) Cooling of the adsorption-

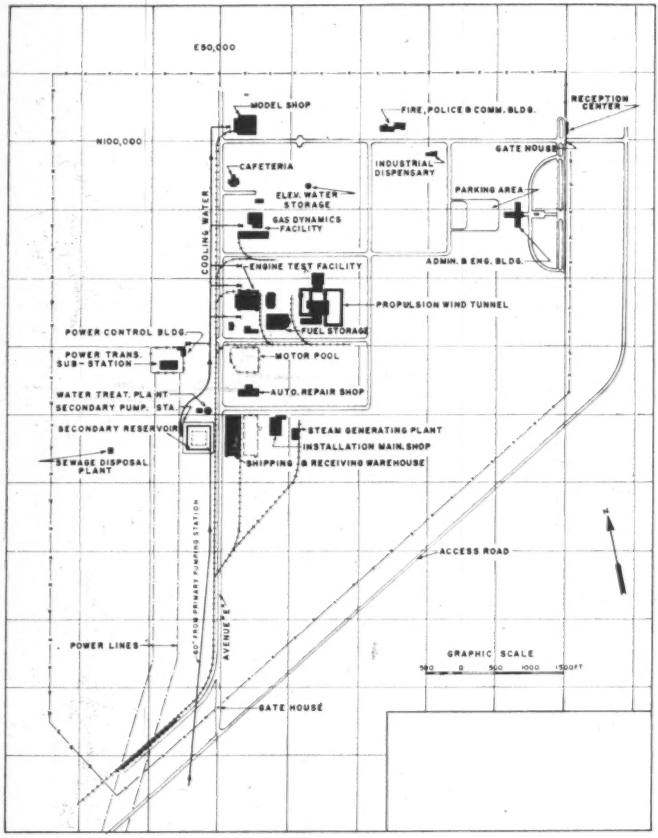



Fig. 2—Facilities location plan

*Note: Mach = 1.0 represents the speed of sound, about 1120 fps or 760 mph at ordinary atmospheric conditions. Transonic generally means from Mach = 0.8 to 1.4, Supersonic from Mach = 1.2 to 5.0, and Hypersonic means above Mach = 5.0.*

type air driers; (4) Air conditioning for control rooms and offices.

The summation of individual water flows amounts to 43,400 gpm, but the estimated maximum demand is 25,000 gpm.

### Propulsion Wind Tunnel

The third principal test unit being constructed at the Center is the propulsion wind tunnel, designed for development testing of full-scale, operating, ram-jet and turbo-jet power plants as installed in aircraft and missiles, as well as full-scale components of aircraft and missiles. The compressor drive will require 216,000 hp.

Because of the considerable differences between transonic and supersonic operation, the tunnel will have two test sections, one for the transonic circuit (Mach = 0.8 to 1.6) and one for supersonic operation (Mach = 1.4 to 3.5). Each section will be in a separate closed circuit having a separate compressor, both compressors being driven from a common power source in the middle. Installation and instrumentation work can be carried on in one section while the other section is engaged in test operation.

To provide for the testing of full-scale propulsion units, the size of each test section will be approximately 16 x 16 ft in cross section and about 30 ft long.

To remove products of combustion from this pair of tunnels, a mechanical scavenging system will be provided, utilizing the exhauster equipment of the engine test facility previously described. To replace the scavenged air, a make-up supply of clean, dry, tempered air will be provided by the supply system of the engine test facility. By adjusting the relative amounts of scavenged and of make-up air in the closed circuits, the pressure can be controlled from that corresponding to sea-level to a pressure which simulates more than 75,000 ft altitude, within the limitations imposed by the power available.

For control of air temperatures in this pair of tunnels, coolers are provided to dissipate the heat of compression at temperature levels which will provide standard altitude temperatures within the test sections.

The compressor system will represent the largest single rotating machine in the world. Both transonic and supersonic compressors will be of the axial flow multi-stage type, having tip diameters of over 25 ft. The largest blades have a span of nearly 6 ft and a chord of about 2 ft at the root.

The supersonic compressor consists of a number of barrels which can be disconnected and bypassed as desired, for the sake of efficient operation over a wide range of inlet flows and pressure ratios. The external bypass shell of this compressor will be 55 ft in diameter.

The central drive power source consists of four motors, two being of 83,000 hp each and two of 25,000 hp.

Cooling water is required to remove heat from such sources as the total drive energy of 216,000 hp maximum, and from air conditioning for control rooms and offices.

Maximum flow of cooling water for this facility will be 111,000 gpm. This does not include spray cooling of exhaust gases, nor the cooling water requirements of the engine test facility when the latter is operated in conjunction with the propulsion wind tunnel for scavenging and make-up air supply. Some of the cooling water which is discharged from the tunnel cooling coils of the propulsion wind tunnel will be re-used in exhaust cooling sprays.

### Other Cooling Water Requirements

The final distribution mains of the cooling water system run from the pumping station at the secondary reservoir for about one mile northward along Avenue E, as shown on Fig. 2. Buildings and installations located on or close to this distribution main will use cooling water rather than sanitary water for any considerable requirements for refrigeration and air conditioning. Requirements are briefly described as follows:

1. *Power Control Building*: Air conditioning, plus cooling of a synchronous condenser ..... 550 gpm

2. *Cafeteria*: Air conditioning and refrigerators ..... 200 gpm

3. *Model Shop and Instrument Laboratory*: Air conditioning, plus water chilling for photo laboratory ..... 265 gpm

4. *Sanitary Water Treatment Plant*: The sanitary and fire fighting water requirements of the Center are supplied from the secondary cooling water reservoir to the water treatment plant. This treated water is used for condensing in small air conditioning systems in buildings which are too far away from Avenue E to justify the cost of connecting to the cooling water mains. Capacity of the (initial) water treatment plant is 1,500,000 gpd, or ..... 1,050 gpm
(This quantity is not pumped by the secondary pumping station.)

### Cooling Water Distribution

The summation of all maximum cooling water requirements is about 267,000 gpm for the initial installations at the Center. The amount of electric power initially available, however, is such that not all facilities can be operated at full power simultaneously. The estimated maximum demand for cooling water is 150,000 gpm, and the secondary pumping station is designed for this initial capacity. This plant has six horizontal pumps each rated at 25,000 gpm against 230 ft total pumping head, and each being driven by a synchronous motor of 1750 hp, 4160 volts, 3 phase, 60 cycle. Control of these pumps will be manual, with all test facilities scheduling their operations long enough in advance to enable the pumping station operators to put the proper number of pumps into operation. Discharge from the secondary pumping station is through an 84-in. main, with branches of suitable sizes going to the various points of application. Distribution mains are of welded steel pipe, tar-enameled inside and out, buried with at least 4 ft of earth cover. Branch take-offs are valved. Shut-off pressure of the pumps is 140 psig. In addition to the six large pumps there are three pumps each rated at 2,000 gpm in the secondary pumping station. These small pumps are under automatic control, responsive to the discharge pressure in the distribution mains. They serve to keep up pressure in the distribution system during periods of light demand, and are

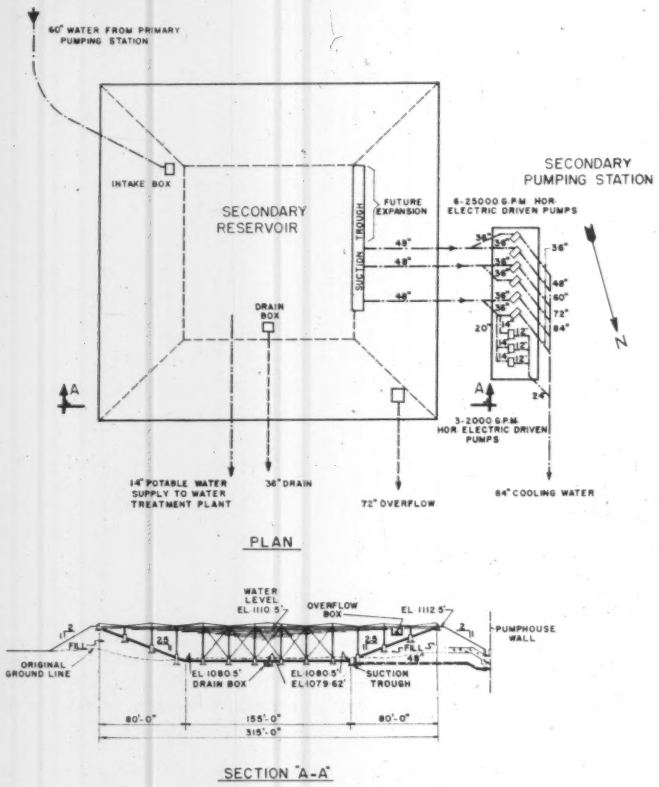



Fig. 3—Secondary reservoir and pumping station

sized to take care of increased air conditioning requirements when certain planned facilities are added in the foreseeable future.

The secondary pumping station is so laid out that it can be increased in capacity to a maximum of 450,000 gpm. The initial test facilities are located on the east side of Avenue E. Most of the large future installations are planned for areas west of this avenue, and a parallel distribution main will be located west of the present main to avoid the necessity for piping cross-overs.

### Secondary Reservoir

As shown on Fig. 3, the secondary reservoir for cooling water is of about 12,000,000 gal net capacity, having earth-embankment sides, concrete lined on sides and bottom, with a cover of corrugated asbestos-cement sheets to exclude sunlight. The bottom 2 ft of reservoir depth is for sedimentation space. Water for the adjacent sanitary water treatment plant flows by gravity from a floating intake for the sake of minimum turbidity.

This reservoir is sized to permit operation of test facilities drawing 150,000 gpm maximum, while water from the primary reservoir is pumped into this secondary reservoir at a maximum rate of 100,000 gpm. The reservoir volume was based upon the anticipated maximum duration of tests requiring full flow. As the Center's requirement for cooling water increases toward the estimated ultimate flow of 450,000 gpm, it will undoubtedly be necessary to construct one or more additional secondary reservoirs, as well as to increase the initial 100,000-gpm capacity of the primary pumping station, and to install one or more additional pipe lines which deliver to the secondary reservoir.

### Primary Pumping Station and Discharge Pipe Line

About 4 mi south of the secondary reservoir is the primary pumping station, located at the nearest part of the Elk River Reservoir where a steep bank is available for the station and intake. The pipe line carrying the discharge from this station to the secondary reservoir is 60-in. inside diameter welded steel pipe, tar-enameled inside and out, and buried with at least 2 ft of earth cover. Careful study was given to the question of using larger pipe, up to 72-in. size, for the sake of lower friction loss and consequent savings in pumping horsepower, but the lower cost of the 60-in. pipe, together with the probability that initial operations would permit running most of the time at partial capacity, proved the deciding factors. It is estimated that initial operations will normally call for two out of the four pumps to be in operation, with full-capacity operation the exception rather than the rule. Improved load factor and reduced demand charges should result from the daily scheduling of pump operations for several hours at half capacity.

The primary pumping station, as shown in Fig. 4, initially includes four vertical turbine pumps, each rated at 25,000 gpm against a total pumping head of 255 ft, of which 140 ft is gravity lift. Each of these 3-stage pumps is driven by a synchronous motor of 2000 hp, 4160 volts, 3-phase, 60-cycle, unity power factor, with direct-connected exciter. Control is manual. The capacity of each pump varies from 24,500 gpm at 265 ft maximum head to 30,000 gpm at 200 ft minimum operational head. Except when it is necessary to serve prolonged test runs at maximum flows, it is planned to operate the primary pumping station with

two pumps delivering 60,000 gpm against 200 ft head.

An ever-present hazard, which can affect practically all of the operations in the Center, is the possibility that the power supply may be interrupted without warning, as in the case of a lightning stroke or a severe windstorm. In the 20,300-ft length of 60-in. steel pipe line carrying the discharge from the primary pumping station to the secondary reservoir, a pressure surge of very considerable intensity could develop if a power interruption were to occur during pumping operations, especially if all four pumps were delivering 100,000 gpm through this line at 11.3 fps.

Operations will naturally be carefully scheduled whenever there is any possibility of a storm within the area. The precaution has been taken, however, of installing four surge suppressor valves in the pump discharges. After the 24-in. hydraulically-operated cone valve in each pump discharge, and before the increaser from 24-in. to 36-in. pipe, there is a 24 x 24 x 16-in. tee with a 16-in. gate valve (normally open) and a 16-in. surge suppressor valve in the side outlet. Discharge from the surge suppressor valve goes back to the pump intake chamber. The suppressor valves operate with time delay, and each is electrically interlocked with its pump motor in order to be instantly responsive in case of an electrical failure affecting the pump.

The primary pumps take water from the Elk River Reservoir through intakes which are guarded by trash racks and traveling screens. Under worst anticipated flood conditions the reservoir surface can reach an elevation of 966 ft above mean sea level. Normal pool elevation will be 960 ft, and the worst anticipated condition of draw-down is not lower than 955 ft. The intake structure has two gates, each 10 ft sq. The lower gate is between elevations 921 and 931 ft, the reservoir bottom at this point being at elevation 920 ft. The upper gate is between 940 and 950 ft elevation. The centerline of the lower gate will thus be 34 ft, and that of the upper gate 15 ft, below normal pool surface.

In winter, when maximum precipitation and run-off occur, the upper gate will be used in order to obtain water of the least turbidity. In summer, when there is little run-off and accordingly little turbidity near the reservoir bottom, the lower gate will be used to obtain water at the coldest possible temperature.

The water will be chlorinated to the break point (estimated to be about 5 ppm) at the primary pumping station intake, to assure freedom from algae and other organic growths in the discharge pipe line, the secondary reservoir, the distribution mains, and the cooling coils and heat exchangers. The cover over the secondary reservoir, besides helping to keep the water cool, is also intended to hold down growth of algae, etc., by excluding any sunlight which

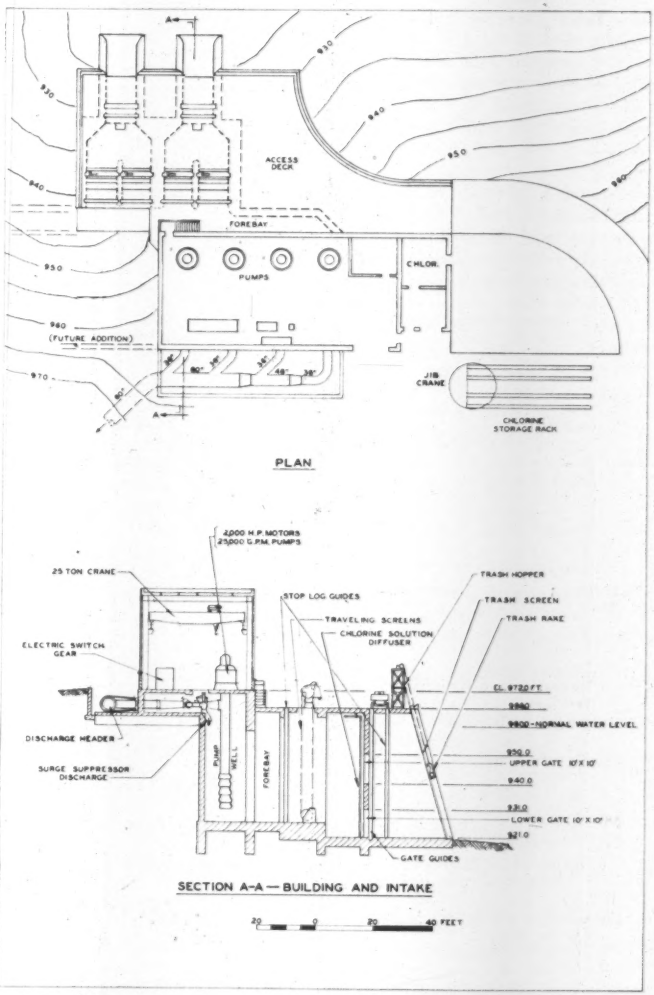



Fig. 4—Primary pumping station

would encourage their development. A rather elaborate chlorinating system is required, since full flow operations will call for 250 lb of chlorine per hour.

### Elk River Dam and Reservoir

The design requirements for the primary reservoir in the Elk River were necessarily formulated well in advance of final design of even the initial test facilities, to say nothing of those future installations which are now being given preliminary study. Construction of the dam was started in the spring of 1950, and the dam and reservoir are expected to be in use by the spring of 1952. Fig. 1 shows the location and extent of the reservoir. The dam is illustrated in Fig. 5.

Estimated ultimate yearly water requirements for which the dam and reservoir were designed were based upon the following data, formulated in 1949 and earlier:

1. *Cooling Water*:
   - *a.* Maximum electrical energy of 1,400,000 hp, load factor of 16.5 percent, maximum water temperature 70 F.
   - *b.* Propulsion test units running for half the operating time of the test facilities.
   - *c.* Cooling water for air conditioning over a period of 18 weeks per year.
2. *Sanitary Water and Fire Protection*:
   - *a.* Sanitary water requirements based on ultimate employment of 7,000 persons at the Center.
   - *b.* Fire protection water requirements based on four 4-hour fires per year.

Quantities of water were determined as follows:

1-*a. Water Required to Remove Heat Input of Electric Drives*:
Installed Power ..... 1,400,000 hp
Estimated Load Factor 16.5 percent
Average Power ..... 231,000 hp
Annual Load 231,000 x 24 x 365 ..... 2,023,560,000 hphr/yr
Average (year-round) temperature rise of cooling water taken as ..... 40 F
Gallons per Hour per hphr = 2545 Btu/hphr ÷ (8.3 x 40 deg rise) = 7.68
Annual Water Required 2,023,560,000 hphr/yr x 7.68 ..... 15,540,000,000 gal/yr

1-*b. Water Required for Cooling of Exhaust Gases*:
13,000,000 gallons test fuel per year x 140,000 Btu per gallon = 1,820,000,000,000 Btu heat to be removed
÷ (8.3 x 40 deg) ..... 5,490,000,000 gal/yr

1-*c. Water Required for Air Conditioning*:
29,600,000 cu ft of spaces to be air conditioned
÷ 4,000 cu ft per ton = 7,400 tons
Tons required for off-season control = 1,700
Average temperature rise during air conditioning season taken as 30 F, requires 1.0 gpm per ton.
Cooling season: 16 hours per day, 7 days per week, 18 weeks per year.
7,400 tr x 1.0 gpm/tr x 60 x 16 x 7 x 18 = 896,000,000 gal/yr
1,700 x 1.0 x 60 x 16 x 7 x 34 = 386,500,000 gal/yr

Total 1,282,500,000 gal/yr

2-*a. Sanitary Water*:
7,000 persons x 1.4 x 60 gpd x 260 days/year ..... 153,000,000 gal/yr

2-*b. Fire Protection*:
7,000 gpm x 60 x 4 hr/fire x 4 fires/year ..... 7,000,000 gal/yr

Total Annual Gallons ..... 22,472,500,000
Total Annual Acre-Feet .... 65,800

The Elk River Dam, of concrete gravity and earth fill type, has a total crest length of 2,943 ft. The area of normal pool surface is 3,980 acres and storage is 80,000 acre feet.

### Return of Discharged Cooling Water

It is planned to return the cooling water to the primary reservoir after use, during at least the first few years of operations. At some later time, part or all of the returning flow may be diverted to discharge into the Elk River below the dam instead of just above it.

Cooling water discharged from the test facilities in the Center will go through buried corrugated metal discharge pipes and a main alongside Avenue E to an outfall into an open discharge ditch about opposite the

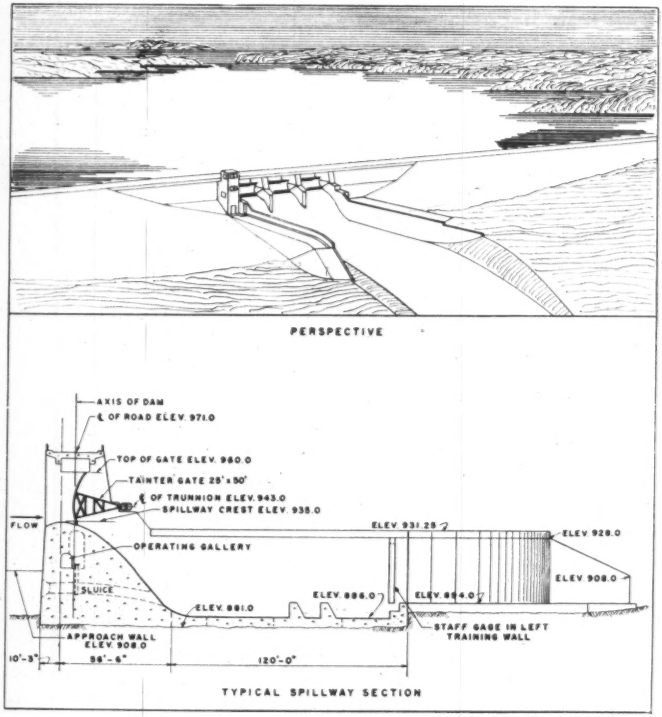



Fig. 5—Elk river dam

secondary reservoir. This ditch will also carry storm drainage from part of the Center, as well as the discharge from the Sanitary Sewage Treatment Plant a short distance downstream.

The ditch is 2.2 mi long and falls about 5 ft. It discharges into a branch of Rollins Creek, through which the flow will travel 3.2 mi to the reservoir, falling about 100 ft in this distance. From the point where Rollins Creek discharges into the reservoir (960 ft pool elevation) to the intake of the primary pumping station, the distance is about 4½ mi measured along creek and river channels, but the shortest distance measured along straight lines is about a mile less.

Neglecting occasional operations of test facilities when small flows of cooling water are discharged at temperatures as high as 170 F, the typical operation involving considerable flows is estimated to result in cooling water discharged into the ditch at about 122 F maximum, estimated as follows:

| | |
|---|---|
| 298,000 kw drive energy x 3,415 | 1,020,000,000 Btu/hr |
| 300 gpm test fuel x 60 x 140,000 | 2,520,000,000 Btu/hr |
| Total | 3,540,000,000 Btu/hr |

150,000 gpm, or 75,000,000 lb of water per hour, will be warmed through 47 F by these additions of heat. Assuming 73 F maximum temperature at the primary station intake, and allowing 2 F deg rise during the flow through pipe lines and secondary reservoir, the 75 F water entering the test facilities will be discharged at 122 F.

An unimpeded flow down Rollins Creek to the reservoir would have several disadvantages. Time of travel from Center to reservoir would be only about 2½ hours. The water would only be cooled from 122 F to about 115 F, and would enter the reservoir in a deaerated condition, carrying silt eroded from the creek channel. There would be occasional pollution of the reservoir by a film of kerosene or other petroleum products. (Appropriate floor drains and storm drains at test facilities in the Center are equipped with oil separators, but there will be occasional pollution by unburned test fuel when an engine blows out and the fuel is carried into the cooling water sprays of the engine test facility.)

It is planned therefore to construct a retention and oil-separating dam and pool at an advantageous point on Rollins Creek, where an inexpensive earth-fill dam can impound a pool of about 1,000 acre-feet with about 125 acres surface area. In this pool the discharge flow of cooling water will release any entrained petroleum products, to rise to the surface and be retained there above the dam by a baffled weir. The film accumulation will be burned off as necessary.

Bleed-off sluices will allow a moderate amount of water to flow constantly, emerging below the dam to splash onto rubble or riprap for the sake of evaporative cooling and reaeration.

One factor in the design of this retention dam and pool is the desirability of cooling the returning flow as much as possible before it enters the reservoir again. Large and prolonged flows of water at 115 F into the reservoir could have an adverse effect on the temperature of the water at the primary station intake. The surface of the reservoir is of course capable of rejecting the added heat into the atmosphere by evaporation and convection, but some of this heat travels downward, and could increase the temperature at the intake by one or two degrees under conditions of heavy and prolonged loads and short-circuited flows from the creek outlet to the pumping station.

The separation of petroleum pollution from the discharge flow of cooling water requires that a separating dam and pool be provided. Only a slight extra cost is involved in making this dam and retention pool large enough to accomplish a considerable cooling effect. Using the 20-year mean dry bulb of 77 F for July at Tullahoma, a pool of about the size described should deliver a steady flow of water out of the bleed-off sluices, with considerable splashing effect, at about 90 F or less, when entering temperature is about 120 F. This temperature should reduce to about 85 F by the time the water travels down the creek and enters the reservoir. The calculations are necessarily rather indefinite, and a large factor of safety in the size of the pool is necessary, because of the unpredictable effect of the non-volatile oil film in interfering with heat flow from pool surface to atmosphere.

### Design Responsibility and Acknowledgments

The Arnold Engineering Development Center has been planned and is being built by the United States Air Force.

Responsibility for construction of the facilities has been delegated by the Air Force to the Corps of Engineers, United States Army. The office of the Tullahoma District Engineer has accordingly been established to carry out this function.

The consulting engineering firm of Sverdrup & Parcel, Inc., St. Louis, Mo., is consultant to the Air Force, with responsibilities which include Site Investigations, Master Plan, detailed design of the test facilities and certain other specialized facilities, and the preparation of Design Criteria for those facilities for which the firm does not prepare detailed plans and specifications.

The consulting firm of Buell-Robert Associates, Architects and Engineers, Denver, Colo., and Atlanta, Ga., is consultant to the Tullahoma District Engineer, with responsibilities which include preparation of detailed plans and specifications for the primary pumping station and intake structure, the cooling water discharge line to the secondary reservoir, the secondary reservoir and pumping station, the sanitary water treatment plant, and the cooling water distribution system.

The Office of the Tullahoma District Engineer prepared plans and specifications for the Elk River Dam and for related projects having to do with the Elk River Reservoir.

For permission to publish the material in this paper and the illustrative sketches, the author wishes to express grateful acknowledgment to the Commanding General, Arnold Engineering Development Center, United States Air Force.

# Honored by Life Membership

LESTER A. CHERRY, partner in the firm, Cherry, Cushing & Preble, consulting engineers, Buffalo, New York, has been elected to Life Membership in the Society, it was announced recently by Council.

Born on September 8, 1883 in Nashville, Tenn., Mr. Cherry was graduated from Vanderbilt University in 1903 with a Bachelor of Engineering Degree.

After his graduation, Mr. Cherry served for three years at Vanderbilt as an instructor in mechanical drawing and in the mechanical engineering laboratory. During the same period, he also assisted Prof. C. S. Brown, of the Department of Mechanical Engineering at Vanderbilt, in his private practice.

L. A. Cherry
Buffalo, N. Y.

In 1907, Mr. Cherry joined the American Radiator Co. in Buffalo as an assistant in the research laboratory and remained with the firm for seven years. His work involved the testing of boilers, radiators, and miscellaneous heating equipment manufactured by the company. During his first year in Buffalo, he prepared a thesis on the testing of blast heaters and for this work Vanderbilt awarded him a Master of Engineering Degree in 1908.

In 1914, Mr. Cherry developed and marketed a vapor heating system, and three years later began a consulting engineering practice devoted principally to heating and ventilating. This firm is now Cherry, Cushing & Preble and does a general consulting engineering business in civil and mechanical engineering.

REUBEN N. TRANE, chairman of the board of the Trane Co., La Crosse, Wis., has been elected to Life Membership in the Society, it was announced recently by Council.

Born on September 13, 1886, in La Crosse, Mr. Trane was graduated from the University of Wisconsin in 1910 with a B.S. degree in mechanical engineering.

Mr. Trane entered the industry in 1913 when he took over as president of his father's plumbing and heating establishment. This shop, founded by Mr. Trane's father in 1886, was the forerunner of the Trane Co. Under Mr. Trane's guidance, the business has grown from a small, local

R. N. Trane
La Crosse, Wis.

entity to become one of the leading operations in the industry.

After Mr. Trane entered the business, plumbing activities were discontinued and the company was incorporated to manufacture exclusively vapor heating systems. In the 38 years that Mr. Trane served as president, the Trane line was broadened to include heating, ventilating, air conditioning, and other heat transfer equipment. As the product line was widened, Mr. Trane became the holder of 27 patents for improvements in heating, ventilating, and air conditioning.

In recognition of his eminent professional contributions as an engineer and business executive, Mr. Trane recently was honored with a distinguished service citation from his alma mater. He was recommended for this award by the faculty of the College of Engineering, with the approval of the Board of Regents of the University.

Mr. Trane, who was elected chairman of the Trane board in 1951, is married and has three children. His son, R. James Trane, is president of the Trane Co., Ltd., in Canada and manager of the manufacturing plant in Scranton, Pa.

H. H. WRIGHT, owner of the H. H. Wright Co., manufacturers representatives, Kansas City, Mo., has been elected to Life Membership in the Society, according to a recent announcement by Council.

Born on October 19, 1886, at Farmington, Minn., Mr. Wright was graduated from the

H. H. Wright
Kansas City, Mo.

University of Minnesota in 1909 with a degree in mechanical engineering.

Mr. Wright began his business career shortly after graduation when he joined the American Blower Co., Detroit, in the apprentice course. He remained with American Blower for about a year and then left to join the C. A. Dunham Co. in Marshalltown, Iowa, as a draftsman.

In 1913, he was appointed to take charge of the Dunham Company's sales office in Kansas City and has been connected with the firm in that area ever since. In addition, Mr. Wright's firm provides representation for a number of other manufacturers in the heating industry.

Mr. Wright joined the Society in 1917.

J. J. Yager
Buffalo, N. Y.

JOHN J. YAGER, Goergen-Mackwirth Engineering Co., Buffalo, New York, has been elected to Life Membership in the Society, it was announced recently by Council.

Born on September 20, 1886, in Leitchfield, Ky., Mr. Yager was graduated from the University of Kentucky in 1907 with a degree in mechanical engineering. He began his business career in 1907 with the Buffalo Forge Co. as a field sales and construction representative on ventilating projects. He remained with that firm until 1916 when he left to join the American Blower Co. as a sales representative, serving in this position until 1921. Concurrently, in 1921 he joined with John Goergen and Frederick Mackwirth to form the Goergen-Mackwirth Co., heating, ventilating, air conditioning, and sheet metal contractors and engineers, and in 1922 acquired sole ownership and became president and board chairman of this firm.

In July, 1945, he joined with his son, Gilbert, and with William L. McAfee to form the Goergen-Mackwirth Engineering Co., a sales and design engineering organization. About a year later he joined with the same parties to form the Buffalo Fabricating Co., Inc., a light-gage metal parts fabricating organization.

Mr. Yager is a member of the Sheet Metal Contractors National Association, the New York State Sheet Metal Contractors Association, the Engineering Society of Buffalo, and the Buffalo Executives Association. In addition to his son Gilbert, he has two other children, W. Stuart and Carol Marie.

# Warm-Air Perimeter Heating

## Temperature Drop in Ducts Embedded in Concrete Floors† —Part II

By J. R. Jamieson*, R. W. Roose**, S. Konzo***, and H. T. Gilkey††, Urbana, Ill.

**SUMMARY — This second report deals with the temperature distribution and heat emission of a concrete floor slab, heated by means of a warm-air perimeter duct. The work was conducted in the Floor Slab Laboratory at the University of Illinois. Both the floor surface temperature distribution and the heat emission from the floor surface were studied for an embedded feeder duct connecting the furnace to the perimeter duct. Uniformity of floor surface temperatures along the feeder duct was obtained by varying the thickness of concrete between the duct and the floor surface.**

**The temperature drop of the air flowing between any two stations in both the feeder and perimeter duct was found to be primarily a function of duct-air temperature and velocity. Good agreement was obtained between the calculated and experimental values of temperature drop. Practical design curves have been presented for estimating the temperature drop through 8-in. diameter embedded ducts for various conditions of duct-air temperature, duct-air velocity, outdoor temperature, and type of edge construction.**

A WARM-AIR perimeter heating system provides one means for obtaining warmer floors in homes built with concrete floors laid directly on the ground. In this system, the warm air from the furnace is delivered through sub-floor feeder ducts to the perimeter duct which is embedded in the floor along the outer walls. All of the heated air leaves the perimeter duct and enters the rooms through registers located under windows and in other areas where the heat losses are high. Thus, heat is supplied to the rooms by convection from registers and by a combination of radiation and convection from the heated floor surface.

In order to design a perimeter heating system properly, it is necessary to have data concerning the rate of heat emission from the floor surface over the perimeter and feeder ducts, the magnitude of the heat losses through the edge of the floor slab and to the ground, and the decrease in duct-air temperature as the air flows from the furnace to the various registers. It is also desirable to have information on the effect of such variables as floor coverings, types of registers and fittings, size of windows, etc., upon the performance of the complete system.

The discussion in a previous paper[1] has included the overall objectives of this investigation, a description of the laboratory, the floor surface temperatures over the *perimeter* duct, as well as the heat emission rates from bare and carpeted floors over the perimeter duct. This second report presents specific information on:

1. The magnitudes of floor surface temperatures, as well as the rate of heat emission (panel effect) from the floor over the *feeder* duct.
2. The magnitudes of and decreases in temperature of the air flowing through both the embedded feeder and perimeter ducts.

For each of the above objectives, a number of independent variables existed or were separately introduced. These variables included: (1) construction of the floor slab with four different applications of edge insulation, (2) the temperatures and velocities of the air circulating through the embedded ducts, and (3) weather effects, such as outdoor temperature, solar intensity, wind velocity and direction, and precipitation.

### Description of Equipment

The Floor Slab Laboratory was constructed in 1947 for the specific purpose of studying methods of insulating unheated concrete floor slabs.[2] The one-story building was modified in 1949 to accommodate concrete floor slabs with embedded perimeter heating ducts as shown in Fig. 1. The four types of floor slab edge construction investigated during the 1949-50 and the 1950-51 heating seasons are shown in Fig. 2. A complete description of the laboratory, the instrumentation, and the equipment was given in the previous paper.[1] The laboratory was operated during the 1949-50 heating season with an electric furnace providing warm air at controlled temperatures and velocities to a single perimeter duct along the north and east walls.

†This investigation is a part of the cooperative project jointly sponsored by the *Engineering Experiment Station of the University of Illinois* and the *National Warm Air Heating and Air Conditioning Association*, and is the second of a series dealing with a research investigation conducted in the Floor Slab Laboratory at the University of Illinois.

*Research Associate in Mechanical Engineering, University of Illinois. Junior Member of ASHVE.
**Research Assistant Professor of Mechanical Engineering, University of Illinois, Associate Member of ASHVE.
***Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.
††Research Assistant in Mechanical Engineering, University of Illinois.

Presented at the 58th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, St. Louis, January 1952.

[1]Exponent numerals refer to References.

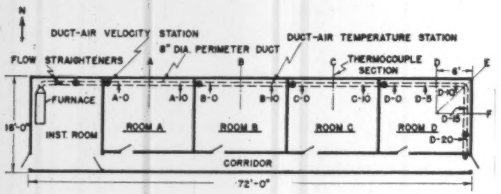



Fig. 1—Floor plan of laboratory

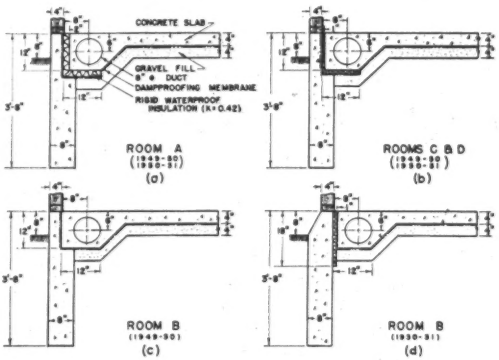



Fig. 2—Types of edge construction

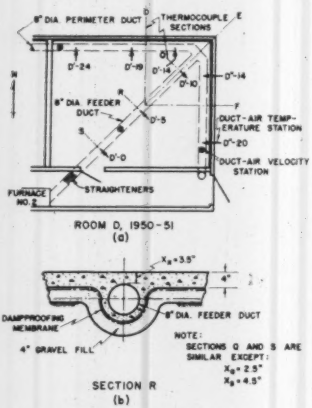



Fig. 3—Feeder duct location (a) plan view (b) cross-section view

Warm air was not introduced into the rooms from the perimeter duct as is the normal procedure in a residence,[3] but room-air temperatures were maintained at 72 F at the 30-in. level by means of supplemental electric heaters. This deviation from normal procedure was considered necessary in order to study the temperature and heat emission characteristics of the embedded duct alone, without adding complications caused by allowing air to discharge from the registers into the rooms.

For the 1950-51 heating season, the floor of the corner room, D, was provided with a feeder duct, as shown in Fig. 3. A separate furnace, No. 2, supplied warm air to the feeder duct, which was pitched upward from the sub-floor plenum under the furnace to the tee fitting at the corner of the room. The pitch of the sloping feeder duct was 1 in. in 5 ft and was intended to provide a more uniform floor surface temperature over the duct. The two outlet ends of the 8-in. diameter tee fitting were connected to the perimeter duct with 45 deg elbows.

Complete instrumentation for temperature measurement was provided, consisting of approximately 600 thermocouples made of No. 24 B & S gage copper and constantan wires. The measurements[4] of floor surface temperatures were made at intervals along the thermocouple sections, which are shown in Figs. 1 and 3. The duct-air temperatures were observed at the temperature stations designated in Fig. 1 as A-O through D-20, and in Fig. 3 as D′-O through D′-24. In each room, the number O refers to the reference station, and the numbers 5, 10, 14, 19, 20, and 24 refer to the linear distances measured from the reference stations. At each station, nine thermocouples were placed in a grid so that the thermocouples were located in the centers of equal concentric areas. Duct-air velocities were measured by means of a standard Pitot tube and 20-point traverse at the seven stations shown in Figs. 1 and 3.

Continuous and daily records of outdoor, room-air, floor surface, duct-air, and other critical temperatures were made throughout the investigation. Additional studies of the duct-air velocities and temperatures were made periodically at stations in each room.

## Floor Surface Temperatures Over the Feeder Duct

Studies made with the perimeter duct have been presented in the previous paper.[1] The floor surface temperature distribution and heat emission rates from the floor over the perimeter duct were found to vary with (1) duct-air temperature, (2) duct-air velocity, (3) outdoor temperature, and (4) application of edge insulation.

Similar studies with the feeder duct arrangement shown in Fig. 3 were made during the 1950-51 heating season. In these studies, the duct-air velocities were maintained at 500 fpm, 750 fpm, and 900 fpm, while the duct-air temperatures ranged from 100 F to 160 F.

A typical pattern of floor surface temperatures over the feeder duct and adjoining perimeter duct is shown in Fig. 4(a). The isotherms, representing lines of equal floor surface temperatures, are nearly parallel over the feeder duct, indicating a practically constant pattern of floor surface temperatures for a length of duct of about 10 ft. This uniformity might seem to be contrary to anticipated results, since the duct-air temperature decreased with distance from the furnace, and the floor surface temperature would be expected to follow the same trend. However, in the case of the duct arrangement shown in Fig. 3, where a gradual reduction in thickness of concrete over the duct was used, the effect of the decrease of the duct-air temperature with distance was apparently compensated for by a reduction in the thermal resistance of the concrete above the duct. Over the perimeter duct, however, where a constant

thickness of 2 in. of concrete was used between the duct and the floor surface, the isotherms indicate a definite decrease in floor surface temperature with distance. An increase in floor surface temperatures over the junction of the feeder and perimeter ducts was also observed. This increase was attributed not only to the increased air turbulence in the fittings, which tended to reduce the surface film resistance of the duct wall, but also to the concentration of heat flow from both the feeder and perimeter ducts in the corner of the room.

The floor surface temperature, as shown by the profile in Fig 4(b), reached a maximum value directly over the duct, decreased rapidly on both sides, and approached the temperature of the room air at a distance of from 2 to 3 ft from the duct. Thus, the feeder duct supplied heat to the room from a strip of floor about 5 ft wide throughout its entire length. The total rate of heat emission from the floor surface over the feeder duct was calculated by means of the King equation for natural convection and the Stefan-Boltzmann equation for radiation, as discussed in a previous paper.[1] The rate varied from 35 to 110 Btu per (hour) (linear foot of feeder duct), depending primarily on the duct-air temperature; and to some extent on duct-air velocity, depth of feeder, and outdoor temperature. The rate of heat emission from the floor per foot of feeder duct was about 70 percent greater than that for each foot of perimeter duct with the same duct-air temperature and velocity [Reference 1, Fig. 10(a)].

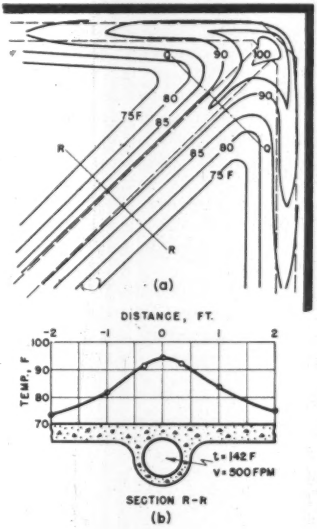



Fig. 4—Floor surface temperature distribution (a) isothermal patterns on floor (b) distribution perpendicular to axis of duct

Any changes in either the duct-air temperature or duct-air velocity affected the floor surface temperatures over the feeder duct in a manner similar to that observed over the perimeter duct.[1] That is, the floor surface temperatures increased when either the duct-air temperature or duct-air velocity was increased. The effect of outdoor conditions on the floor surface temperatures over the

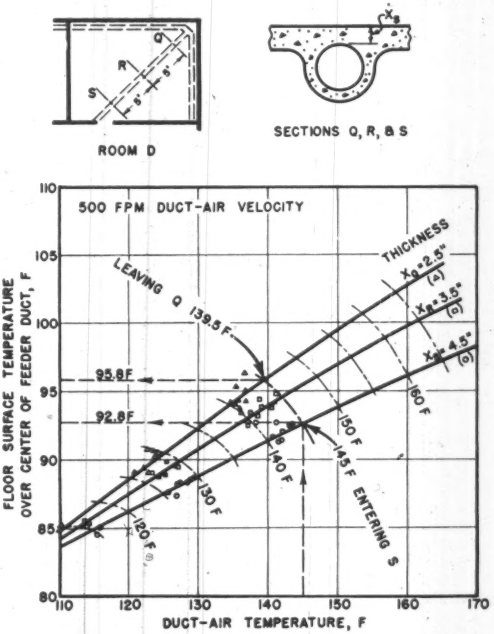



Fig. 5—Effects of duct-air temperature and thickness of concrete on the floor surface temperatures over center of feeder duct

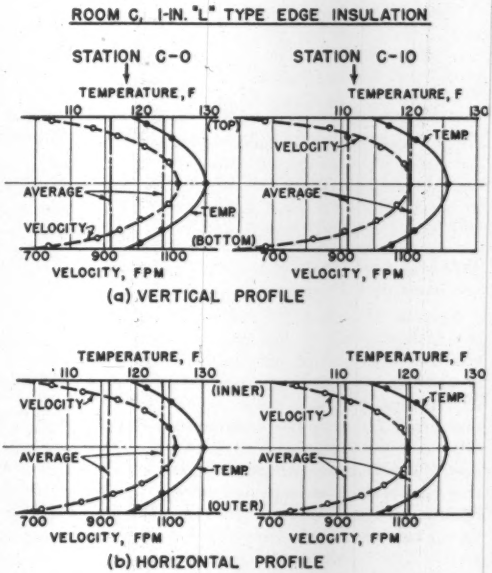



Fig. 6—Typical duct-air temperature and velocity profiles in perimeter duct under Room C

feeder duct was small, with slightly lower temperatures occurring in colder weather as a result of the increased radiation heat transfer between the floor and the colder exterior surfaces.

The thickness of concrete between the floor surface and the sloping feeder duct affected the floor surface temperatures over the duct as shown in Fig. 5. For a duct-air temperature of 145 F at the entrance of test section, Station S, the temperature of the duct air leaving the test section at Station Q was found to be 139.5 F. The corresponding floor surface temperatures at S and Q were found to be 92.8 F and 95.8 F. That is, the floor surface temperature over the duct increased slightly as the distance from the furnace was increased. As far as the floor surface temperatures were concerned, therefore, the effect of the decrease in duct-air temperature with distance was more than offset by the effect of the reduction in thickness of concrete over the duct. When the entering duct-air temperature was approximately 115 F, the compensating effects were equal and the floor surface temperatures over the center of the duct were 85 F from S to Q.

The temperature of the floor surface directly over the duct was calculated for various values of duct-air temperature and duct-air velocity. The equations used in the calculations, and a comparison with the measured values, are included in the Appendix. The calculated values of floor surface temperatures were found to be in reasonably good agreement with those obtained experimentally.

## Temperature Drop in Embedded Ducts

*General Discussion.* — Between any two stations in the duct surrounded by a medium at lower temperature, a decrease in the average temperature of the air stream occurs; this is referred to as the *temperature drop*. In the design of a perimeter heating system, an evaluation of the temperature drop is useful for determining (1) the rate of heat flow through the duct surface to the room and to the ground, and (2) the enthalpy of the air flowing into the rooms through the various registers.

The difference in enthalpies between stations can be calculated from the average temperature and average velocity of the air stream, provided that temperature profiles and velocity profiles at each station are similar.[5] The typical temperature and velocity profiles shown in Fig. 6 indicated that the corresponding patterns were similar and that the enthalpy determinations could be made from the average values at each station.

The factors which affect the temperature drops in the embedded ducts may be grouped into the following classifications:

*A.* Characteristics of the ducts and immediate surroundings.

1. Length, size, and shape.
2. Material, such as galvanized-iron and vitrified clay tile.
3. Depth below floor surface.
4. Construction surrounding ducts, such as placement and conductivities of edge insulation, gravel, concrete, etc.

*B.* Characteristics of the outer environment.

5. Air movement and temperature within the room.
6. Weather conditions.
7. Ground conditions including temperatures, moisture content, and moisture movement.

*C.* Air flow characteristics within the duct.

8. Average temperature.
9. Average velocity.

For the investigation of temperature drops, items 1 through 5 were maintained constant, and the effects of items 6 through 9 were investigated.

*Theoretical Analysis.* — The enthalpy of the air stream at any station in the embedded ducts can be evaluated by the equation:

$$h = m\ (0.24t + Wh_w) \quad \ldots\ldots(1)$$

*where*

$h$ = Enthalpy of the duct air, Btu per (hour).
$m$ = Weight of dry air circulated, pound per hour, which is equal to velocity ($v$) × area ($A$) × density ($\rho$) × 60.
$t$ = Temperature, Fahrenheit.
$W$ = Humidity ratio of moist air, pounds of water vapor per pound of dry air.
$h_w$ = Specific enthalpy of condensed water at standard pressure, Btu per pound of water.

If a temperature difference exists between stations 1 and 2 in a section of duct, the decrease in enthalpy of the air stream may be approximated by

$$\Delta h = 0.24m\ (t_1 - t_2) \quad \ldots\ldots(2)$$

The use of this simplified equation, in which the difference of enthalpy of water vapor has been omitted, gave values of $\triangle h$ that were within one percent of the true differences in enthalpy. For the results discussed in this paper, therefore, Equation 2 was used.

Between stations 1 and 2 in the duct, the enthalpy decrease is equal to the lateral heat loss from the duct to the outer environment, which, in the case of the feeder duct, would be the room air and the ground, and in the case of the perimeter duct would be the room air, the ground, and the outdoor air. This can be expressed by the equation:

$$\Delta h = (LA/R_T)\ (t_d - t_e) \quad \ldots\ldots(3)$$

*where*

$L$ = Length of duct between stations 1 and 2, feet.
$A$ = Surface area, square feet per linear foot of duct.
$R_T$ = Total thermal resistance of the materials surrounding the duct, (hour) (square feet) (Fahrenheit) per Btu.
$t_d$ = Mean duct-air temperature, Fahrenheit = $(t_1 + t_2)/2$
$t_e$ = Equivalent temperature of surrounding heat sinks, Fahrenheit degrees. This was determined by weighting the temperatures of the ground ($t_g$), the outdoor air ($t_o$), and the room air ($t_r$), proportional to the rate of heat flow. The latter distribution was determined by a graphical method which will be discussed in a separate paper (Part III)*. For the types of floor and edge constructions shown in Figs. 2 and 3(b), the values of $t_e$ were found to be:

$t_e = 0.55\ t_o + 0.35\ t_r + 0.10\ t_g$ [Fig. 2(a)]
$t_e = 0.57\ t_o + 0.34\ t_r + 0.09\ t_g$ [Fig. 2(b)]
$t_e = 0.62\ t_o + 0.30\ t_r + 0.08\ t_g$ [Fig. 2(c)]
$t_e = 0.58\ t_o + 0.33\ t_r + 0.09\ t_g$ [Fig. 2(d)]
$t_e = 0.75\ t_r + 0.25\ t_g$ [Fig. 3(b)]

*Warm-Air Perimeter Heating, Part III — Heat Losses from Floor Slab, by J. R. Jamieson, R. W. Roose, and S. Konzo (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, p. 128, this issue).

In the case of the Floor Slab Laboratory, the ground temperature, $t_g$, measured at a depth of 20 ft, was found to be practically constant at 58 F. By combining Equations 2 and 3, the temperature drop is

$$(t_i - t_i) = [LA/(0.24m\ R_T)] (t_d - t_e) \quad \ldots\ldots\ldots (4)$$

The total resistance, $R_T$, can be considered as the sum of the duct-air film resistance, $R_f$, and the combined resistance of the other surrounding materials, $R_r$, or

$$R_T = R_f + R_r \quad \ldots\ldots\ldots\ldots\ldots (5)$$

*where*

$R_f$ = Duct-air film resistance, (hour) (square foot) (Fahrenheit degree) per Btu.

$R_r$ = Combined resistance of materials surrounding duct such as concrete, gravel, etc, (hour) (square foot) (Fahrenheit degree) per Btu.

The duct-air film resistance, $R_f$, can be calculated[6] by the equation:

$$R_f = 1/h_c \doteq (D/0.0225k)\ (\mu/DG)^{0.8}\ [(K/c_p\ \mu)]^{0.33} \quad \ldots\ldots\ldots (6)$$

*where*

$h_c$ = Unit thermal conductance by convection, Btu per (hour) (square foot) (Fahrenheit degree).

$D$ = Cylinder diameter, feet.

$k$ = Thermal conductivity of air, Btu per (hour) (square foot) (Fahrenheit degree per foot thickness).

$\mu$ = Fluid viscosity, pound per (hour) (foot).

$G$ = Fluid mass velocity, pound per (hour) (square foot).

$c_p$ = Specific heat at constant pressure, Btu per (pound) (Fahrenheit degree).

For given mean duct-air, outdoor, room-air, and ground temperatures and type of construction, Equation 4 can be written as:

$$m\ (t_i - t_i)\ (R_f + R_r) = (LA/0.24)\ (t_d - t_e) \quad \ldots (7)$$

and

$$m'\ (t_i' - t_i')\ (R_f' + R_r) = (LA/0.24)\ (t_d - t_e) \quad \ldots (8)$$

where $m$ and $m'$ refer to two different rates of weight flow. It may be noted that the film resistance, $R_f$, will be affected by the difference in flow rates, but the term $R_r$ is considered to remain unchanged. Thus for the constant conditions of mean duct air, outdoor, room air, and ground temperatures,

$$m'\ (t_i' - t_i')\ (R_f' + R_r) = m\ (t_i - t_i)\ (R_f + R_r) \quad \ldots (9)$$

or

$$(t_i' - t_i') = (t_i - t_i)\ (m/m')\ [(R_f + R_r)/(R_f' + R_r)] \quad \ldots\ldots\ldots (10)$$

the unknown, $R_r$, can be replaced by

$$\left[\frac{LA(t_d - t_e)}{0.24m(t_i - t_i)} - R_f\right]$$

and Equation 10 can be expressed in terms of the constant and measured quantities in the form:

$$(t_i' - t_i') = \frac{LA(t_d - t_e)}{0.24m'\left[R_f' - R_r + \dfrac{LA(t_d - t_e)}{0.24m(t_i - t_i)}\right]} \quad \ldots\ldots\ldots (11)$$

From Equation 11, the effect on the temperature drop by a change in velocity, and, hence, in flow rate, $m$, can be calculated. It may be observed that the new temperature drop can be obtained from the original temperature drop and the difference in calculated values for the film resistances.

Similarly, the effect of changes in temperatures of outdoor air, ground, or room air on the temperature drop for a given duct-air velocity and mean duct-air temperature can also be determined from Equation 4 as:

$$[(t_i - t_i)/(t_d - t_e)] = [LA/(0.24\ m\ R_T)] \quad \ldots\ldots (12)$$

and

$$[(t_i' - t_i')/(t_d - t_e')] = [LA/(0.24\ m\ R_T)] \quad \ldots\ldots (13)$$

or

$$(t_i' - t_i') = (t_i - t_i)\ [(t_d - t_e')/(t_d - t_e)] \quad \ldots (14)$$

Hence, a new temperature drop can be obtained from the original temperature drop and the revised value of $t_e$, which, in turn, is dependent upon the temperatures of the surrounding heat sinks.

Comparisons of the calculated temperature drops, as obtained from Equations 11 and 14, were made with the experimental results and will be discussed in the following sections.

*Temperature Drop in Feeder Duct.* — For a constant duct-air velocity and outdoor temperature, and for a singular type of construction, the temperature drop was found to increase as the mean duct-air temperature was increased. The magnitude of this effect is shown by the slope of the curve in Fig. 7 for a velocity of 500 fpm; the solid line represents an average of the experimental data. For example, consider a 10-ft section of duct through which warm air is delivered at a velocity of 500 fpm and at a mean temperature of 110 F. The data shown in Fig. 7 indicate that the decrease in duct-air temperature was at an average rate of 0.4 deg per foot of duct, or 4 deg for the 10-ft section. In other words, the air would enter this particular section of duct at 112 F and leave it at a temperature of 108 F. Had the mean duct-air temperature been 150 F, the total temperature drop through the 10-ft section would have been 7 deg or the entering and exit temperatures of duct air would have been 153.5 F and 146.5 F, respectively.

The calculated temperature drops in the feeder duct for duct-air velocities of 300 fpm, 750 fpm and 900 fpm are shown as broken-line curves in Fig. 7. The calculated values were obtained by substituting in Equation 11 the observed data for a velocity of 500 fpm. The experimental results actually obtained at duct-air velocities of 750 fpm and 900 fpm are represented by the plotted points and show good agreement with the curves based on the calculations. Both the calculated and experimental results indicated that larger temperature drops occurred with a decrease in duct-air velocity.

The magnitude of the temperature drop in the feeder duct was undoubtedly affected to some extent by such variables as outdoor weather conditions, ground temperatures, ground moisture content, and distance from outer walls. None of these variables was individually of sufficient magnitude to affect the temperature drop. However, the cumulative effect of the variables undoubtedly contributed to the scattering of the data shown in Fig. 7.

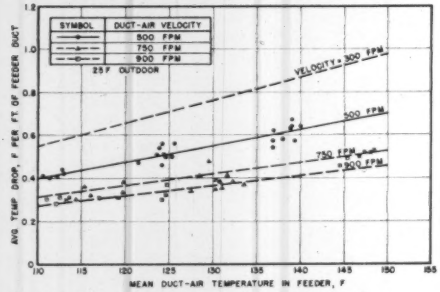



Fig. 7—Rate of temperature drop in feeder duct

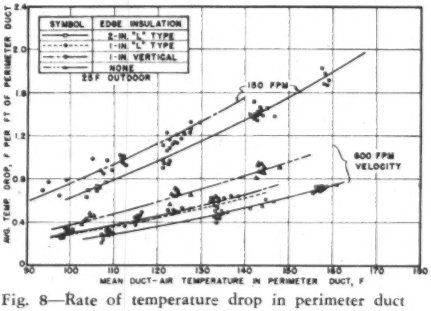



Fig. 8—Rate of temperature drop in perimeter duct

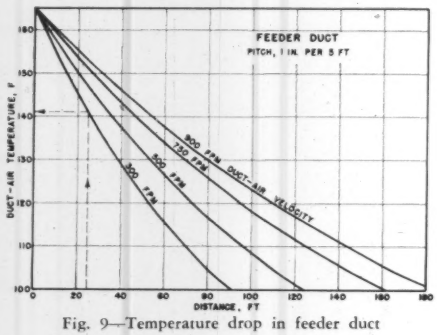



Fig. 9—Temperature drop in feeder duct

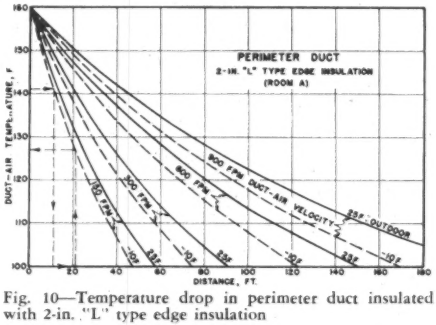



Fig. 10—Temperature drop in perimeter duct insulated with 2-in. "L" type edge insulation

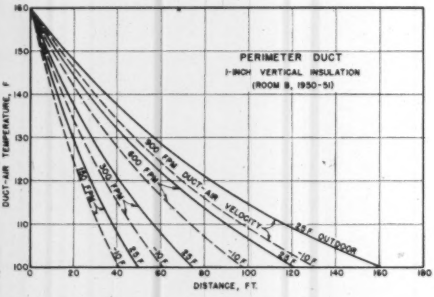



Fig. 11—Temperature drop in perimeter duct insulated with 1-in. vertical edge insulation

*Temperature Drop in Perimeter Duct.* — For a duct-air velocity of 600 fpm, each of the four curves shown in the lower part of Fig. 8 is an average representation of the observed data for four types of edge construction. For a duct-air velocity of 150 fpm, the experimental data are represented by the plotted points, whereas the calculated temperature drops based upon Equation 11 are represented by the two curves. As in the case of Fig. 7, excellent agreement was obtained between the experimental and calculated results for this velocity. In all cases, an increase in temperature drop occurred when the mean duct-air temperature was increased.

The four curves in the lower part of Fig. 8 show a comparison of the effectiveness of various amounts of insulation at the edge of the floor slab. The application of 2-in. L type edge insulation reduced the temperature drop of the air stream approximately 35 percent as compared with that for the uninsulated floor. The use of either type of 1-in. edge insulation produced almost identical temperature drops, which were approximately 20 percent lower than those for the uninsulated floor.

Much of the scattering of data in Fig. 8 may be attributed to the variations in outdoor temperature. As indicated in the theoretical analysis, the calculated temperature drops for a given duct-air condition and type of edge construction could be made by means of Equation 14 for various values of $t_o$ which, in turn, could be determined for assumed values of outdoor temperature, $t_o$. Such calculated temperature drops for a number of outdoor temperatures were compared with the observed temperature drops and were found to be in good agreement. Hence, considerable confidence was placed in the validity of Equation 14 as well as Equation 11. These two equations were therefore used in later analyses for determination of design data beyond the limitation of the conditions experienced.

*Temperature Drop in Fittings.*—An analysis of the temperature drops between the inlet and outlet of the fittings indicated that the 45-deg elbow and tee combination produced a drop equivalent to that for a 10-ft length of feeder duct. Similarly, a 90-deg elbow used in a section of perimeter duct produced a temperature drop equivalent to that obtained in a 3-ft straight section of perimeter duct.

### Design Data for Temperature Drops

The results of the temperature drop study are presented in a more useful manner in Fig. 9, for the feeder duct, in Fig. 10, for the perimeter duct with the 2-in. L type edge insulation, and in Fig. 11, for the perimeter duct with 1-in. vertical edge insulation. To illustrate the application of these data, consider an example of a perimeter heated residence in which the furnace delivers air to the feeder ducts at a temperature of 165 F under a design outdoor condition of —10 F. The air flows at a velocity of 300 fpm through 15 ft of feeder duct to a combination 45-deg elbow and tee fitting. At that point, the velocity of the air is reduced to 150 fpm as the air travels through 10 ft of perimeter duct embedded in a floor slab provided with 2-in. L type edge insulation. Information is desired on the duct-air temperature at the beginning of the perimeter duct and at the entrance to the register.

The total equivalent distance from the sub-floor plenum to the beginning of the perimeter duct was 25 ft, consisting of 15 ft of feeder duct and 10 equivalent ft for the 45-deg elbow and tee fitting. From Fig. 9, which is based upon a plenum temperature of 165 F, the duct-air temperature at a total distance of 25 ft will be about 141 F. The data in Fig. 10 show that, for a duct-air velocity of 150 fpm and an outdoor temperature of —10 F, the duct-air temperature of 141 F intercepts the curve at a distance of 11 ft. At a distance of 21 ft, which is comprised of the initial 11 ft and the 10 ft length of the perimeter duct, the intercept with the curve occurs at a duct-air temperature of 127 F. This is the temperature of the air leaving the perimeter duct and entering the register.

The mean air temperature in the feeder duct of 153 F was determined from the plenum temperature of 165 F and the temperature of 141 F at the tee fitting. This mean air temperature used in connection with Fig. 10 of Reference 1 gave a value of 1480 Btu per hour heat emission from the floor surface over the feeder duct. Similarly, the mean air temperature in the perimeter duct of 134 F was determined from temperatures at the tee fitting and the register, and a heat emission rate of 350 Btu per hour was obtained. The register-air temperature of 127 F was used in connection with Equation 2 to give a register delivery of 2910 Btu per hour. Hence, it may be observed that the design curves of Figs. 9, 10, and 11 together with the heat emission curves[1] provide sufficient information to estimate the heat delivery from the register as well as from the feeder and perimeter ducts.

The perimeter duct, located with its center 8 in. from the outer wall and 6 in. below the floor surface, consisted of an 8-in. diameter galvanized-iron duct embedded in concrete. The feeder duct, also 8 in. in diameter, was attached to the perimeter duct at the exposed corner of a room with two 45-deg elbows and a tee fitting. None of the air flowing through the ducts was discharged into the rooms. The following discussion applies specifically to this arrangement.

The feeder duct for the distribution of warm air from the subfloor plenum to the perimeter duct provided heat to the floor over an area about 5 ft wide and throughout its entire length. The rate of heat emission from the heated floor to the room varied from 35 to 110 Btu per (hour) (linear foot of feeder duct), depending primarily upon the duct-air temperature. The rate of heat emission from the floor was about 70 percent greater than that for the perimeter duct for the same duct-air temperature and duct-air velocity.

The magnitude of the floor surface temperatures over the feeder duct was dependent upon the mean duct-air temperature, duct-air velocity, and depth of feeder duct. For a given combination of duct-air temperature and duct-air velocity, a uniform floor surface temperature was attained by sloping the feeder duct upwards from the furnace to the tee fitting with a pitch of 1 in. in 5 ft. A floor surface temperature of 85 F over the center of the duct was observed along its entire length when the entering duct-air temperature was 115 F and the duct-air velocity was 500 fpm. These duct-air conditions are representative of those for an *average* winter day in this locality. In colder weather (—10 F outdoor) the floor surface temperatures were about 98 F near the subfloor plenum and about 105 F near the end of the feeder duct. The floor area having a surface temperature in excess of 85 F was limited to strips less than 2 ft wide over the feeder duct.

Calculated values of the temperature of the floor surface directly over the center of the feeder duct were determined on the basis of parallel heat flow through a uniform thickness of concrete. For this calculation, the total resistance to heat flow from the duct air to room air was considered to be composed of: (1) the duct-air film resistance, (2) the resistance of concrete, and (3) the room-air film resistance. The calculated surface temperatures were about 2.5 to 5.0 deg higher than the measured values. Considering the fact that the actual paths of heat flow were not parallel, the calculated and actual surface temperatures can be considered to be in good agreement.

The temperature drop of the duct air was defined as the decrease in the average temperature of the air as it flowed between any two stations in the duct. Each of the following factors *decreased* the magnitude of the temperature drop when the remaining factors were maintained constant:

1. Lower mean duct-air temperatures.
2. Higher duct-air velocities.
3. Higher outdoor temperatures.
4. Application of edge insulation.

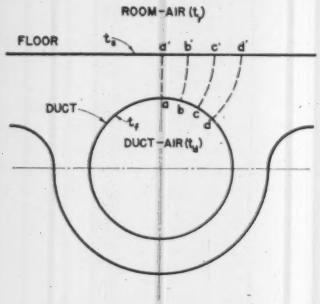



Fig. 12—Cross-section of duct

As far as the temperature drop in the feeder duct is concerned, only items 1 and 2 were found to have a major effect. On the other hand, all four items affected the temperature drop in the perimeter duct. For a known relationship between temperature drop and duct-air temperature, the values of temperature drop could be calculated for other velocities and for different outdoor temperatures. Such calculated values were found to be in good agreement with experimental results.

Several fittings commonly used in perimeter heating systems were studied and the difference between entering and exit temperatures were reported in terms of temperature drop for equivalent straight sections. A 45-deg elbow and tee combination produced a drop equivalent to that of 10 ft of feeder duct. A 90-deg elbow used in a section of perimeter duct produced a temperature drop equal to a 3 ft straight section of perimeter duct.

For practical application, curves were developed to determine the magnitude of the temperature drops in the feeder duct as well as in the perimeter duct insulated with 1- and 2-in. thicknesses of edge insulation.

## Acknowledgments

This paper is a report of an investigation conducted in the Floor Slab Laboratory under the terms of a cooperative agreement between the *National Warm Air Heating and Air Conditioning Association* and the *Engineering Experiment Station of the University of Illinois.* The assistance of J. G. Blick, assistant in Mechanical Engineering, and J. T. Laorden, graduate student, is gratefully acknowledged. These results will ultimately comprise part of a University of Illinois Engineering Experiment Station bulletin.

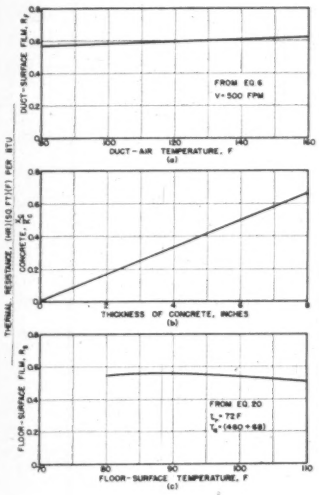



Fig. 13—Thermal resistance of: (*a*) duct-air film (*b*) concrete between duct and floor (*c*) floor-surface film

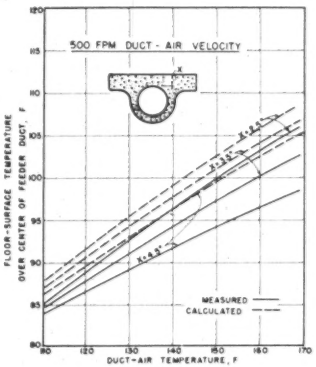



Fig. 14—Comparison of calculated and measured floor-surface temperatures over center of feeder duct

2. Temperature and Heat Loss Characteristics of Concrete Floors Laid on the Ground, by H. D. Bareither, A. N. Fleming, and B. E. Alberty (*American Artisan*, Vol. 87, No. 3, March 1950.)

3. Warm-Air Perimeter Heating, *Manual 4, National Warm Air Heating and Air Conditioning Association*, Cleveland, Ohio, 1950.

4. ASHVE Research Report No. 943 — Study of the Application of Thermocouples to the Measurement of Wall Surface Temperatures, by A. P. Kratz and E. L. Broderick (ASHVE Transactions, Vol. 39, 1933, p. 55.)

5. Temperature Drop in Ducts for Forced-Air Heating Systems, by A. P. Kratz, S. Konzo, and R. B. Engdahl (*University of Illinois Engineering Experiment Station Bulletin* 351, 1944.)

6. *Heat Transmission*, by W. H. McAdams (2nd Edition, McGraw-Hill Book Co., New York, 1942.)

## References

1. Warm-Air Perimeter Heating, Part I — Heat Emitted from Floor Surface, by J. R. Jamieson, R. W. Roose, and S. Konzo (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, July 1951, p. 117.)

## APPENDIX

### *Calculation of Floor Surface Temperatures and Comparison with Measured Values*

*General Discussion.* — This investigation was conducted with an 8-in. diameter feeder duct and an 8-in. diameter perimeter duct, specifically arranged as shown in Figs. 1, 2, and 3. Although additional experiments with other duct sizes and arrangements might have been desirable, such studies were not conducted. It was necessary, therefore, to provide methods of estimating the performance of such systems from a theoretical analysis of the arrangement actually studied. This phase of the analysis is confined to the calculation of floor surface temperatures together with a comparison of the calculated and measured values.

*Calculation of Floor Surface Temperatures.* — The heat flow from the duct air to the room air along any of the paths a-a', b-b', c-c', or d-d', shown in Fig. 12, can be expressed by the equation:

$$(Q/A) = [t_d - t_r]/[R_f + (x_c/k_c) + R_s] \quad \ldots\ldots \text{(A-1)}$$

*where*

$Q/A$ = Heat flow per unit area of duct surface, Btu per (hour) (square foot).

$t_d$ = Mean duct-air temperature, Fahrenheit degrees.

$t_r$ = Room-air temperature Fahrenheit degrees.

$R_f$ = Duct-surface film resistance, (hour) (square foot) (Fahrenheit degree) per Btu.

$R_s$ = Floor-surface film resistance, (hour) (square foot) (Fahrenheit degree) per Btu.

$x_c$ = Thickness of concrete along path of heat flow a-a', b-b', etc, in inches.

$k_c$ = Thermal conductivity of concrete, assumed to be 12 Btu per (hour) (square foot) (Fahrenheit degree per inch of thickness).

Along any heat flow path the rate of heat flow through the duct-surface film is the same as that through the concrete and through the floor-surface film: that is, the following modifications of Equation A-1 are identities:

$$(t_d - t_f)/R_f = [(t_f - t_s)/(x_c/k_c)] = (t_s - t_r)/R_s = (t_d - t_r)/[R_f + (x_c/k_c) + R_s] \quad \text{.....(A-2)}$$

*where*

$t_f$ = Duct-surface temperature, Fahrenheit degree.

$t_s$ = Floor-surface temperature, Fahrenheit degree.

One method of determining the floor-surface temperature consisted of equating:

$$(t_d - t_r) = (t_d - t_f) + (t_f - t_s) + (t_s - t_r) \quad \text{.....(A-3)}$$

and substituting appropriate terms from Equation A-2 to obtain:

$$t_s = [R_s t_d + t_r(R_f + x_c/k_c)]/[R_s + R_f + x_c/k_c] \quad \text{....(A-4)}$$

In this case the floor-surface temperature was expressed as a function of duct-air and room-air temperatures.

The values obtained by means of Equation A-4 were independently confirmed by the use of a second equation, which was derived from the first two parts of Equation A-2 as follows:

$$t_s = t_f - [x_c (t_d - t_f)/(k_c R_f)] \quad \text{.....(A-5)}$$

In this equation, it was necessary to use measured values of the duct-surface temperature, which were available for the installation under investigation, but which would not be available for any other arrangement.

For both Equations A-4 and A-5, the resistance of the duct-surface film, $R_f$, was determined from Equation 6. Also, the resistance of the floor-surface film, $R_s$, was determined by means[1] of the King equation for natural convection ($q_c$) and the Stefan-Boltzmann equation for radiation, ($q_r$), as follows:

$$R_s = [(t_s - t_r)/(q_c + q_r)] \quad \text{....(A-6)}$$

or

$$R_s = \frac{t_s - t_r}{[0.28(t_s - t_r)^{.25}] + [0.173 \times 10^{-8} \times 0.82(T_s^4 - T_a^4)]} \quad \text{..(A-7)}$$

*where*

$T_s$ = Absolute temperature of floor surfaces, (460 + $t_s$).

$T_a$ = Absolute temperature of absorbing surface exposed to floor, (460 + 68). A value of 68F was assumed which compared favorably with the actual average surface temperature that was experienced.

The calculated resistances of the duct-surface film, the concrete, and the floor-surface films are shown in Fig. 13. These data were used in Equation A-4 for determining the floor surface temperatures directly over the center of the feeder duct. The calculated values for a duct-air velocity of 500 fpm are shown by the three broken-line curves in Fig. 14 and can be compared with those obtained experimentally, as shown by the solid-line curves. In all cases the calculated floor-surface temperatures were slightly higher than the measured values, a discrepancy that increased as the thickness of concrete between the duct and the floor surfaces was increased. This deviation was attributed to the fact that Equations A-1, A-2, and A-4 were based on the assumption that parallel heat flow existed between the duct and room air, whereas a non-parallel flow actually existed as indicated by the heat-flow lines b-b', c-c', and d-d' in Fig. 12.

Considering the assumptions made in the derivation of Equation A-4, the calculated values of the floor-surface temperatures were in reasonably good agreement with the experimental results.

## Second Supplement to Panel Heating Bibliography

The second supplement to the Bibliography on Panel Heating has recently been compiled by Miss Doris Dietz of the ASHVE Research Laboratory staff. This supplement, covering articles, papers, and reports appearing between January 1 and December 31, 1950, is now available for addition to the Bibliography, published in 1948, and to the first supplement, published in 1950.

ASHVE members may obtain one copy of this supplement without charge by writing to Society Headquarters, 62 Worth St., New York 13, N.Y. Additional copies are 50c each.

Non-members may also obtain copies by writing to Society Headquarters and enclosing 50c for each copy needed.

## EARL SHULTZ RETIRES

Earl Shultz, manager of the Service Buildings Department of the Commonwealth Edison Company, Chicago, retired on January 1 after 39 years with the utility. Mr. Shultz joined the company shortly after his graduation from Ottawa University, Kansas, in 1905.

In 1912, he became manager of the Edison Building on West Adams Street in Chicago. At that time, the structure was known as the Commercial National Bank Building. When Edison acquired Chicago's Marquette Building, Mr. Shultz was also named as its manager. Since 1926, he has headed the utility's buildings department, which includes the northern and central service buildings. In 1918, he was named vice president and manager of the Illinois Maintenance Co., an Edison subsidiary which furnishes steam for heating buildings in part of the loop area.

Earl Shultz

Mr. Shultz is a past president of the *National Association of Building Owners and Managers, Chicago Building Managers Association* and the *National District Heating Association*. During World War II, he was head of civilian defense for Chicago's downtown area.

## R. A. BIGGS JOINS FRANKI COMPANY

R. A. Biggs, well known in the field of development and architectural engineering, and a member of the Society, has become associated with the Franki Foundation Co., it was announced recently by A. J. Bulger, president of the company. Mr. Biggs will have his headquarters in New York City.

Mr. Biggs was graduated from Harvard University in 1932 and since has been with several large companies. Prior to joining the Franki Co., he was director of architectural development for the Crucible Steel Co. of America.

# Warm-Air Perimeter Heating

## Heat Losses from Floor Slab† —Part III

By J. R. Jamieson*, R. W. Roose**, and S. Konzo††

Urbana, Ill.

**SUMMARY — The heat losses from a concrete floor slab, heated by means of a warm-air perimeter duct, have been investigated in the Floor Slab Laboratory at the University of Illinois. A large portion of the subfloor heat losses occurred at the outer edge of the floor slab. Of the four types of edge construction studied, that which incorporated a 2-in. thick *L type* edge insulation was found to be most effective in reducing the subfloor heat losses. These losses were reduced when either the duct-air temperature or duct-air velocity was decreased. Practical design values of the subfloor heat losses are presented for two types of edge construction.**

**Heat-flow diagrams for each of the floor constructions indicated the proportionate heat flow into the room, through the edge insulation, and into the ground and by-passing the insulation.**

**A supplemental study of the durability of nine different materials for use as edge insulation was conducted. In addition, an analysis was made of the time lags involved in heat transfer by conduction from the perimeter duct. These results cover only one phase of the complete investigation.**

THE TERM *perimeter heating* is generally applied to warm-air heating systems for basementless structures built over concrete slabs. The heated air is delivered from a furnace through subfloor feeder ducts to an embedded perimeter duct that completely encircles the slab along its outer edge. The air is delivered into the rooms through registers located at the outer walls and returned to the furnace through return-air intakes located at the inside wall or ceiling. Since the perimeter duct is located near the outer edge of the floor in close proximity to the cold ground and outdoor air, inadequate insulation in this area could result in excessive heat losses from the floor slab.

Previous investigations by Dill[1] and Bareither[2] on the heat losses from unheated concrete floor slabs gave floor losses ranging from 40 to 75 Btu per (hour) (linear foot of exposed edge) depending upon the type and amount of edge insulation. In a small home, this amount would constitute approximately 10 to 20 percent of the total heat loss. When the outer edge of the floor is heated, as is done with a perimeter heating system, even larger floor losses can be anticipated. Hence, adequate floor insulation is mandatory in order to avoid excessive fuel consumption.

Several methods are available for insulating concrete floor slabs laid directly on the ground. Insulation of the entire underside of the floor slab is seldom used unless the entire floor is to be heated, since the heat loss in the center section of the building is relatively small.[2, 3] With a perimeter heating system, therefore, it is sufficient to insulate only the outer edge of the floor slab. The insulation can be applied either vertically down the inside face of the foundation wall to a reasonable depth, or turned under the perimeter duct in the form of an "L". The type of edge construction is usually determined by the builder after consideration is given to the installation costs and the materials available.

In other papers[3,4] the discussion included the overall objectives of this investigation and a description of the laboratory, as well as the observed values of floor surface temperatures, heat emission rates from the floor, and temperature drops of the air in the embedded ducts. This third report provides an analysis of the heat losses from the floor slab as affected by edge construction, duct-air temperature, duct-air velocity, and weather effects.

### Description of Floor Slab Construction and Instrumentation

The Floor Slab Laboratory, as shown in Fig. 1, was equipped with four rooms so arranged as to minimize the effect of direct solar radiation on the exposed walls. The insulated partition walls between rooms were 6 in. thick and extended to a depth of 4 ft below the floor to minimize any heat transfer between adjoining spaces.

The four types of floor-slab edge construction investigated over the two-year period are shown in Fig. 2. The edge insulation used consisted of a rigid and waterproof cellular glass,* having a thermal conductivity of 0.42 Btu per (hour) (square foot) (Fahrenheit per inch). The floor slabs were constructed of 1:2:4 concrete. A 4-in. layer of coarse gravel was placed under the floor to provide suitable drainage and minimize the

†This investigation is a part of the cooperative project jointly sponsored by the *Engineering Experiment Station of the University of Illinois* and the *National Warm Air Heating and Air Conditioning Association* and is the last of a series dealing with a research investigation conducted in the Floor Slab Laboratory at the University of Illinois.

*Research Associate in Mechanical Engineering, University of Illinois. Junior Member of ASHVE.
**Research Assistant Professor of Mechanical Engineering, University of Illinois. Associate Member of ASHVE.
††Professor of Mechanical Engineering, University of Illinois. Member of ASHVE.

Presented at 58th Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, St. Louis, January 1952.

[1]Exponent numerals refer to References.

*A 300-day study was conducted to determine the durability of cellular glass and eight other materials commonly used as edge insulation in the field. The results are given in Appendix A.

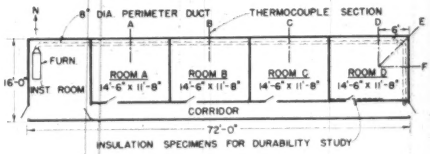
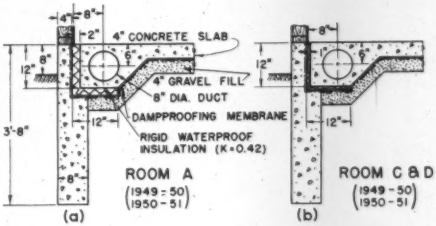



Fig. 1—Floor plan of laboratory



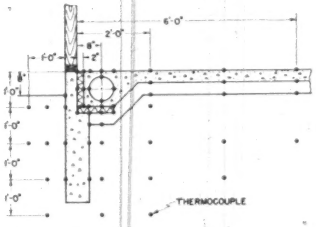




Fig. 3—Location of slab and ground thermocouples under Room A

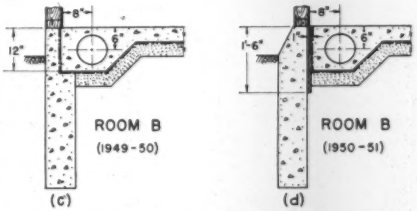



Fig. 2—Types of edge construction

capillary rise of moisture from the soil. A duplex-kraft paper, or dampproofing membrane, was placed over the gravel fill; all joints were lapped and sealed with coal tar. The soil under and adjacent to the Laboratory contained 3 ft of fill composed of 18 percent clay, 53 percent silt, 24 percent sand, and 5 percent gravel. Under the fill was the original black silty-clay topsoil which extended to a depth of 4 ft. The soil adjacent to the building was graded 8 in. below the floor level and was sloped for proper drainage.

Temperature measurements were made with approximately 600 thermocouples, a large number of which were placed in the soil and gravel in a section perpendicular to the axis of the perimeter duct and at the center of the outer wall of each room. These thermocouple sections are indicated on the floor plan of Fig. 1, and a typical section is shown in Fig. 3. Instrumentation was also provided to measure the indoor-relative humidities, the electrical inputs to the supplemental room heaters, the duct-air velocities, the soil moisture content, and the level of the water table under the building.

## Procedure

This phase of the investigation was undertaken to determine both the magnitude and the direction of the heat flow from the perimeter duct. The rate of heat flow through the foundation wall to the outdoor air and the rate of heat flow into the ground were of particular importance. These heat flows, referred to as *slab-edge loss* and *ground loss*, respectively, were unavailable for heating the room.

This study was conducted during the 1949-50 heating season with the types of construction shown in Figs. 2(a), 2(b), and 2(c). The construction shown in Fig. 2(d) was used in Room B during the 1950-51 season. The study of the heat losses for the construction shown in Fig. 2(a) was repeated in 1950-51 to provide a norm for the data obtained during the two seasons.

Warm air was circulated continuously through the perimeter duct at a constant entering duct-air temperature and constant duct-air velocity during each of the series of studies listed in Table 1. After the completion of a given series of studies, changes were made in duct-air temperature or velocity and four days were allowed for the ground conditions to stabilize. The results of the time lag study which will be discussed in Appendix B indicated that this four-day interval was sufficient.

## Method of Analysis

The heat flow from the surface of the perimeter duct is transmitted by conduction along three principal paths. As discussed in the other papers,[3, 4] part of the heat is conducted from the surface of the perimeter duct to the floor above, is then transferred to the room air and surrounding surfaces by convection and radiation, and finally flows to the outdoor air as part of the usual transmission or infiltration heat losses. The remainder of the heat is conducted from the duct either downward to the ground (ground loss), or outward through the foundation wall to the outdoor air (slab-edge loss).

The heat flow along the three paths can be considered as parallel heat flow from a single source, and, hence, the magnitude of the heat flow along any one of the paths will affect the heat flow along the remaining paths. For example, if the heat flow from the duct to the room is altered by a change in room-air temperatures, not only will the heat flow to the room be changed, but also the heat flow to the slab-edge and the ground will be changed. In order to maintain room conditions typical of those for actual practice, a room-air temperature of 72 F was maintained by a supplemental heater in each room.

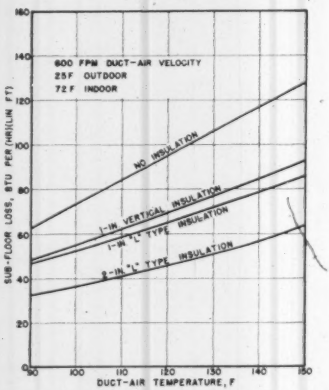



Fig. 4—Subfloor heat losses for four types of edge construction

Two independent methods were available for the study of the slab-edge and ground losses. In the *heat balance method*, the heat emitted from the floor surface was subtracted from the total heat loss from the perimeter duct. The remainder, which is the sum of the ground loss and the slab-edge loss, is referred to as the *subfloor loss*. In the *flow diagram method*, heat-flow lines were developed from isothermal (constant temperature) lines, which in turn were based upon the temperatures of the duct and adjacent materials. A comparative analysis of the heat-flow lines for each type of construction provided means for determining the distribution of heat flow among the three main paths.

## Determination of Losses by Heat Balance Method

The subfloor loss could be evaluated from Equation 1:

$$(Q_s/L) = (Q_t/L) - (Q_p/L) \quad . (1)$$

*where*

$(Q_s/L)$ = subfloor loss, Btu per (hour) (linear foot of exposed edge).

$(Q_t/L)$ = total heat gain from perimeter duct, Btu per (hour) (linear foot).

$$= 60\ v\ A\ \rho\ c_p\ (t_1 - t_2) \quad . (2)$$

$v$ = duct-air velocity, fpm.

$A$ = area of duct, square feet.

$\rho$ = air density, pounds per cubic foot.

$c_p$ = specific heat of air, 0.24 Btu per (pound) (Fahrenheit degree).

$(t_1 - t_2)$ = temperature drop of duct air per linear foot, Fahrenheit degrees, determined from Reference 4.

$(Q_p/L)$ = heat emitted to the room through the floor, Btu per (hour) (linear foot), determined from Reference 3.

The subfloor losses for various types of edge construction based on an average outdoor temperature of 25 F and 600 fpm duct-air velocity are shown in Fig. 4. These curves show a definite reduction in the subfloor loss by the application of edge insulation. For example, as compared with the results of the uninsulated slab, the subfloor heat loss was reduced about 25 percent by the application of both the vertical insulation and the 1-in. L type insulation, and 50 percent by the 2-in. L type insulation.

The values shown in Fig. 4 are for specific combinations of operating conditions, and, hence, are not applicable to conditions which differ widely from those stated. The effects of varying the duct-air velocity, duct-air temperature, and outdoor temperature can be readily determined from the available data.[3, 4] A summary of the calculated values obtained for a wide range of conditions is presented in Table 2. For purposes of comparison, the values obtained

Table 1—Operating Conditions[a] for Slab Edge and Ground Loss Study

| Test Series[b] | Date of Series Start | Date of Series End | Primary Objectives of Study | Avg Duct-Air Temp, F | Avg Duct-Air Velocity, fpm |
|---|---|---|---|---|---|
| ABCD-1 | 11/29/49 | 12/22/49 | Calibration for Above Ground Heat Losses | 60 | 0 |
| ABCD-2 | 12/26/49 | 1/8/50 | Slab Edge and Ground Losses | 100 | 590 |
| ABCD-3 | 1/12/50 | 1/19/50 | Slab Edge and Ground Losses | 130 | 590 |
| ABCD-4 | 1/23/50 | 2/3/50 | Slab Edge and Ground Losses | 145 | 610 |
| ABCD-5 | 2/7/50 | 2/17/50 | Slab Edge and Ground Losses | 130 | 915 |
| ABCD-6 | 2/21/50 | 3/10/50 | Slab Edge and Ground Losses | 100 | 915 |
| ABCD-7 | 3/14/50 | 3/29/50 | Slab Edge and Ground Losses | 100 | 375 |
| ABCD-8 | 3/30/50 | 4/10/50 | Calibration for Above Ground Heat Losses | 100 | 375 |
| ABCD-9 | 4/11/50 | 4/17/50 | Time Lag and Response Study | Varied | 375 |
| AB-11 | 12/1/50 | 12/20/50 | Calibration for Above Ground Heat Losses | 60 | 0 |
| AB-12 | 12/24/50 | 1/3/51 | Slab Edge and Ground Losses | 115 | 150 |
| AB-13 | 1/7/51 | 1/30/51 | Slab Edge and Ground Losses | 130 | 150 |
| AB-13a | 1/31/51 | 2/6/51 | Slab Edge and Ground Losses (with rug in room A) | 130 | 150 |
| AB-14 | 2/9/51 | 2/15/51 | Slab Edge and Ground Losses | 100 | 150 |
| AB-15 | 2/18/51 | 2/27/51 | Slab Edge and Ground Losses | 130 | 520 |
| AB-16 | 3/1/51 | 3/12/51 | Slab Edge and Ground Losses | 130 | 600 |
| AB-17 | 3/16/51 | 3/25/51 | Slab Edge and Ground Losses | 140 | 600 |

[a]Room-air temperatures maintained at 72 F at the 30-in. level.
[b]Letters ABCD refer to rooms used in study. Numbers refer to series sequence.

Table 2—Effect of Controlled Variables on Subfloor Heat Loss

| Item | Case 1 | Case 2 | Case 3 | Case 4 | Case 5 |
|---|---|---|---|---|---|
| *Controlled Variables* | | | | | |
| a. Duct-air velocity, fpm | 600 | 150 | 600 | 600 | 150 |
| b. Duct-air flow rate, cfm | 209 | 52 | 209 | 209 | 52 |
| c. Duct-air temperature, F | 130 | 130 | 130 | 100 | 130 |
| d. Outdoor temperature, F | 25 | 25 | —10 | 25 | —10 |
| e. Edge insulation, type | 2-in.L | 2-in.L | 2-in.L | 2-in.L | 2-in.L |
| *Temperature Drops and Heat-Flow Rates* | | | | | |
| f. Duct-air temperature drop, F/ft (from Ref. 4, Fig. 8) | 0.44 | 1.15 | 0.54 | 0.22 | 1.41 |
| g. Total heat loss, $Q_t/L$, Btu/(hr-ft) (from Eq. 2) | 89 | 58 | 109 | 47 | 72 |
| h. Panel effect, $Q_p/L$, Btu/(hr-ft) (from Ref. 3) | 38 | 32 | 18 | 6 | 12 |
| j. Subfloor loss, $Q_s/L$, Btu/(hr-ft) (from Eq. 1) | 51 | 26 | 91 | 41 | 60 |

Table 3—Subfloor Heat Loss, Btu per (Hour) (Linear Foot of Exposed Edge)

| Outdoor Design Temperature F | Type of Edge Construction 2 in. L Type Fig. 2(a) | 1 in. Vertical Fig. 2(d) |
|---|---|---|
| 25 | 40 | 55 |
| 10 | 55 | 75 |
| 0 | 65 | 85 |
| —10 | 75 | 95 |
| —20 | 85 | 105 |

*Note:* These values are for a room width of 12 ft. For rooms over 12 ft wide, add 2 Btu for each additional foot of width to the above values.

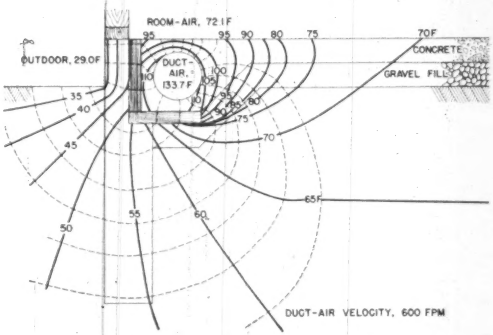



Fig. 5—Heat-flow diagram for 2-in. L type edge construction (Room A)

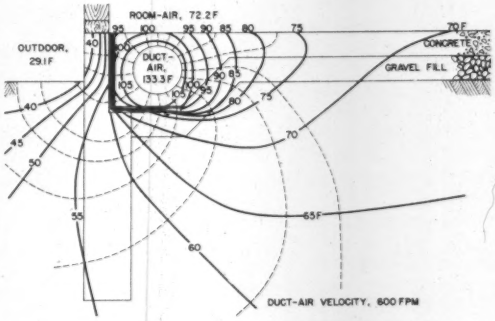



Fig. 6—Heat-flow diagram for 1-in. L type edge construction (Room C)

from Fig. 4 for the 2-in. edge insulation and at a duct-air temperature of 130 F are shown as Case 1, item j. The separate effects on the subfloor losses of the duct-air velocity, outdoor temperature, and duct-air temperature are shown as items j for Cases 2, 3, and 4, respectively. As compared with the results for Case 1, a decrease in duct-air velocity or duct-air temperature was also accompanied by a decrease in the subfloor loss. On the other hand, a decrease in outdoor temperature resulted in a substantial increase in the subfloor loss. Under design conditions of −10 F outdoor temperature, the duct-air temperature[4] would be of the order of 130 F, and the air-flow rates of the perimeter duct would fall within a range of 50 cfm and 200 cfm, depending upon the number of registers served by a given section of perimeter duct. Under these design conditions the subfloor losses would fall within the range of 60 to 91 Btu per (hour) (linear foot of exposed edge), as shown in item j, Cases 3 and 5. For practical design purposes, a mean value of 75 Btu per (hour) (linear foot) is suggested for a −10 F outdoor temperature, as shown in the second column of Table 3.

Similar derivations of subfloor losses are shown in Table 3 for other outdoor design temperatures, and also for the 1-in. vertical edge insulation. The subfloor losses for a warm-air perimeter heating system can be estimated, therefore, by multiplying the appropriate values from Table 3 by the linear feet of exposed edge in the given installation.

Heat losses from the feeder duct were evaluated in a similar manner by utilizing Equations 1 and 2, the duct-air temperature drops, and the heat emission values [3, 4] for the floor surface over the feeder duct. For the purpose of obtaining design data, it was assumed that the feeder duct-air velocity was twice that of the attached perimeter duct and the length of feeder duct did not exceed 30 ft. Under these conditions, and with a 165 F duct-air temperature entering the feeder duct from the subfloor plenum, the heat loss from the feeder duct to the ground was within the range of 8 to 12 Btu per (hour) (foot of feeder duct). Hence for all practical purposes, a value of 10 Btu per (hour) for each foot of feeder duct can be used.

### Determination of Losses by Flow-Diagram Method

From the temperatures observed at each of the stations shown in Fig. 3, heat-flow diagrams were developed by first plotting lines of equal temperature, or *isothermal* lines, for temperature increments of 5 deg. These are shown as solid lines in Figs. 5 through 8. The steep temperature gradient in the edge insulation is illustrated in Figs. 5, 6, and 7 by the close proximity of the isothermal lines in the insulation.

After the isothermal lines had been drawn, it was possible to construct *heat-flow* lines that indicated the direction of heat flow from the perimeter duct (1) through the floor, (2) through the edge insulation, and (3) through the ground and by-passing the edge insulation. Furthermore, by means of the following procedure, the flow lines were spaced to depict 16 paths of equal heat-flow rates:

1. A selection was made of two additional isotherms, 1 deg apart, that were near the heat source (perimeter duct).
2. The total area enclosed by these isotherms was divided into 16 areas of equal heat flow[5].
3. From the boundaries of these 16 areas, heat-flow lines were constructed so that all isotherms were intersected at a 90-deg angle.

The heat-flow lines thus constructed are shown as broken lines in Figs. 5 through 8, from which an evaluation could be made of the relative merits of the different methods of applying edge insulation. From a comparison of the heat-flow diagrams for the uninsulated edge (Fig. 8) with each of the diagrams for the insulated constructions, (Figs. 5, 6. and 7), the following can be observed:

1. The application of insulation reduced the heat loss through the upper portion of the foundation wall. However, this decrease was partially compensated for by an increase in heat flow through the lower portion of the foundation wall. In other words, the addition of a high resistance material near the exposed portion of the foundation caused the heat flow to seek a round-about path through less resistant materials.
2. In the case of the L type insulation, an improvement could be effected by extending the horizontal insulation further under the slab. Similarly, for the 1-in. vertical insulation, the application could be

improved by the use of a depth of insulation greater than 18 in.

A quantitative analysis could also be made of the heat flow from the perimeter duct to the room, to the ground, or through the insulation. The space between two adjacent heat-flow lines represents 1/16 of the total heat emitted from the perimeter duct. Hence, by counting the number of such spaces that eventually terminate on the floor surface, the proportion of the total heat emission that is transmitted to the floor surface can be estimated. For example, in the case shown in Fig. 5 of the floor with 2-in. L type insulation, approximately 6-¾ spaces out of the total of 16 spaces terminated at the floor surface. This represented 42 percent of the total heat conducted away from the duct. Similarly, the 4-¾ spaces showing heat flow through the insulation were equivalent to 30 percent of the total. The remaining 4½ spaces indicated that 28 percent of the total heat emission entered the ground and by-passed the insulation. These percentages, as well as similar values for the three other types of floor construction, are listed in Part A of Table 4. Considering the wide differences in edge construction, the variations in the percentage values for a given item were not large.

However, the percentage values alone do not afford a fair means of comparison of the effectiveness of various edge insulations, since the enthalpy of the air entering the duct was not the same for the four types of edge construction. Therefore, the only fair comparison is that where the percentage values are applied to a case in which identical enthalpies at the entrance of the perimeter duct are maintained. An example showing the application of the percentage values to a specific case is given in Part B of Table 4. In this example, the enthalpy at the entrance of a 10-ft section of perimeter duct (Item 5) was assumed to be 2940 Btu per hour for each of the four constructions. The enthalpy of the air leaving the 10-ft section (Item 6) was determined from the temperature drops reported in Reference 4. The difference in these enthalpies represented the total heat flow from the duct by conduction. The percentage values given as Items 1, 2, and 3 of Table 4 could then be applied to the enthalpy difference to obtain Items 7, 8, and 9. In this example, the subfloor loss (Item 8 + Item 9) was 330 Btu per hour for the 2-in. L type insulation, or 11 percent of the entering enthalpy. Similarly, the subfloor loss for the 1-in. vertical insulation was 416 Btu per hour. The ratio of the subfloor losses for the two types of construction was 416/330 or 1.26, which compared favorably with the ratio determined by the heat balance method and shown in Table 3.

### Example Showing Application of Data

In previous papers,[3, 4] information was presented on the rate of heat emission from the floor surface as well as the temperature drop of the air flowing through the embedded ducts. This information together with the data presented in this paper on subfloor heat losses can be applied to a practical problem as shown by the following example.

Consider the case of the room shown in Fig. 9 where the feeder duct is connected to the perimeter duct at the outer corner of the room, and where registers are located under the windows. For a given design outdoor temperature (−10 F), the heat loss of this room is dependent upon the construction used. In the case of relatively poor construction in which neither wall insulation nor storm sash is used, the design heat loss for above-grade construction could be as large as 13,000 Btu per hour (see Table 5, Item 1). Assume also that a 2-in. L type edge insulation is used along the 27 ft perimeter. The design subfloor heat loss, as determined from the values in Table 3, would amount to 27 x 75 or about 2,000 Btu per hour (see Table 5, Item 2).

The methods used for determining the remaining items in Table 5 are explained in the right-hand column. The panel heating effect from the embedded ducts (Items 9 and 10) amounts to 2,100 Btu per hour, or only 14.2 percent of that required to offset the total room loss. This value was based on an assumption that the feeder duct supplied air only to registers C and E. Had it supplied air to additional registers beyond C

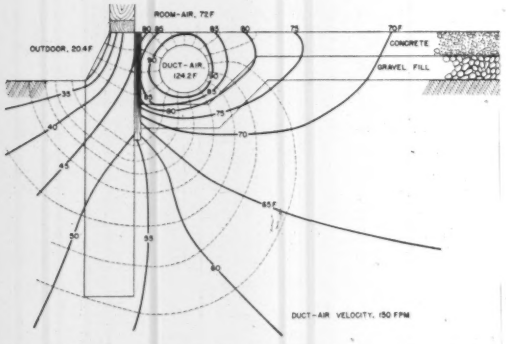



Fig. 7—Heat-flow diagram for 1-in. vertical type edge construction (Room B, 1950-51)

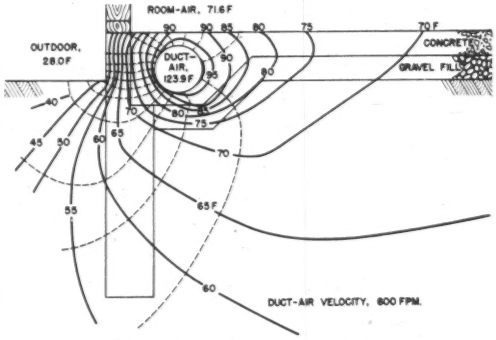



Fig. 8—Heat-flow diagram for uninsulated edge construction (Room B, 1949-50)

**Table 4—Distribution of Heat Flow From Perimeter Duct**

| Item | Description of Item | Type of Edge Insulation | | | |
|---|---|---|---|---|---|
| | | 2 in.-L Fig. 2(a) | 1 in.-L Fig. 2(b) | 1 in. Vertical Fig. 2(d) | None Fig. 2(c) |
| PART A — Percentages of Heat Flow by Conduction from Duct | | | | | |
| 1. | Heat gain into room | 42 | 39 | 37 | 32 |
| 2. | Heat loss through edge insulation | 30 | 37 | 22 | 0 |
| 3. | Heat loss by-passing edge insulation | 28 | 24 | 41 | 68 |
| 4. | TOTAL | 100 | 100 | 100 | 100 |
| PART B — Heat Distribution in 10-Ft Section of Perimeter Duct (Btu per hour) | | | | | |
| 5. | Enthalpy of air entering* | 2940 | 2940 | 2940 | 2940 |
| | *Heat gain to room* | | | | |
| 6. | Enthalpy leaving duct | 2370 | 2310 | 2280 | 2180 |
| 7. | Panel effect from floor | 240 | 246 | 244 | 243 |
| | *Heat Losses* | | | | |
| 8. | Through edge insulation | 171 | 233 | 145 | 0 |
| 9. | By-passing edge insulation | 159 | 151 | 271 | 517 |

*Based upon the following conditions: (1) 130 F duct-air temperature; (2) 150 fpm duct-air velocity; (3) —10 F outdoor; (4) 72 F indoor.

and E, as would be the case in a normal installation, an additional panel effect from the surfaces E-F and C-D would provide a slightly higher percentage. The heat emitted from the registers amounted to 10,700 Btu per hour, or 72.3 percent. In this discussion, all percentage values are stated in terms of room loss under design conditions.

Similar calculations for a room having wall insulation and storm sash, and for which the total heat loss was only 7,500 Btu per hour, gave values of 21 percent and 55 percent for the panel effect and register inputs, respectively. Although the examples shown are for a specific combination of duct sizes and edge construction, the range of 14 to 21 percent for the panel effect and 72 to 55 percent for the register input should be indicative of the performance of warm-air perimeter heating systems in general.

The fact that the subfloor loss is of the order of 14 to 24 percent does not imply that these relatively large values can be attributed entirely to the use of the perimeter type of warm-air heating system. Calculations made of the subfloor loss for a conventional type of warm-air heating system, in which the floor slab is provided with a 2-in. L type edge insulation but is unheated, indicate that the values range from 8 to 16 percent for the two types of building construction mentioned previously. In other words, the warmer floors obtained with the perimeter system would increase the total heat loss about 7 percent as compared with that for a conventional system.

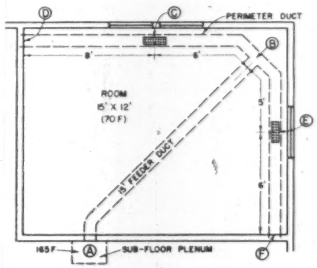



Fig. 9—Example showing application of data

**Table 5—Example of Heat Distribution for Room Shown in Fig. 9**

| Item | Description of Item | Value | Method of Determination |
|---|---|---|---|
| 1. | Above-ground heat loss | 13,000 Btu/hr | Assumed |
| 2. | Subfloor loss | 2,000 Btu/hr | Table 3 |
| 3. | Total loss | 15,000 Btu/hr | Item (1) + Item (2) |
| 4. | Duct-Air Velocity in Feeder Duct | 420 fpm | Item 3/[460 x 0.075 x 0.24 (165-70)] |
| 5. | Duct-Air Velocity in Perimeter Duct | 210 fpm | Item (4) ÷ 2 |
| 6. | Duct-Air Temperature at B in Fig. 9 | 145 F | Reference 4, Fig. 9 |
| 7. | Duct-Air Temperature at Register C in Fig. 9 | 137 F | Reference 4, Fig. 10 |
| 8. | Duct-Air Temperature at Register E in Fig. 9 | 138 F | Reference 4, Fig. 10 |
| 9. | Heat emitted from floor over Feeder Duct | 1600 Btu/hr | Reference 3, Fig. 10, and Ref. 4 |
| 10. | Heat emitted from floor over Perimeter Duct between C and E | 500 Btu/hr | Reference 3, Fig. 10 |
| 11. | Heat emitted from Register C | 5300 Btu/hr | Area (Item 5)x 1.08(Item 7-70) |
| 12. | Heat emitted from Register E | 5400 Btu/hr | Area (Item 5)x 1.08(Item 8-70) |
| 13. | Total heat gain into room | 12,800 Btu/hr | Sum of Items 9, 10, 11, 12. |
| 14. | Ratio: Panel effect/Total Room Loss | 0.142 | (Item 9 + Item 10)/(Item 13 + Item 2) |
| 15. | Ratio: Register Input/Total Room Loss | 0.723 | (Item 11 + Item 12)/(Item 13 + Item 2) |
| 16. | Ratio: Subfloor loss/Total Room Loss | 0.135 | Item 2/(Item 13 + Item 2) |

The perimeter duct arrangement used in this investigation consisted of an 8-in. diameter, galvanized-iron duct embedded in a concrete floor with the duct centered 8 in. from the outer wall and 6 in. below the floor surface. Edge insulation was installed adjacent to the perimeter duct as shown in Fig. 2. None of the air flowing through the ducts was discharged into the rooms. The following discussion applies specifically to this arrangement.

The heat conducted from the surface of the perimeter duct resulted in a heat gain into the room and heat losses through the foundation wall to the outdoor air and to the ground. The subfloor heat loss was found to be a function of duct-air temperature, duct-air velocity, outdoor temperature and type of edge insulation. A decrease in the subfloor loss was effected by a *reduction* in either the duct-air temperature or duct-air velocity, or by an *increase* in outdoor temperature. Of the four types of edge insulation investigated, the 2-in. L type insulation produced the best results. A comparison of the results for the 1-in. L type insulation with the 1-in. vertical insulation indicated little difference in the subfloor heat losses. The uninsulated floor slab produced subfloor heat losses approximately twice as large as those for the slab with the 2-in. L type insulation. Hence, the use of an uninsulated floor slab is not recommended for warm-air perimeter heating installations. Practical design values of the subfloor heat losses for the 2-in. L type insulation and the 1-in. vertical insulation are given in Table 3.

A qualitative analysis of the various methods of applying edge insulation was made by a study of heat-flow diagrams. The study indicated that a 2-in. *thickness* of edge insulation was adequate, that the application of

*L type* edge insulation could be improved by extending it further under the slab, and that the application of *vertical* edge insulation could be improved by extending it to a greater depth.

From an application of the data obtained in this investigation, indications were that the distribution of total heat flow in a perimeter heating system, depending upon the construction used, would be: (1) the subfloor heat loss from 14 to 24 percent; (2) the panel effect from 14 to 21 percent; and (3) the register inputs from 72 to 55 percent. Calculations indicate that the warmer floors obtained with the perimeter system would increase the total heat loss about 7 percent as compared with that for a conventional system.

A supplemental study was conducted on the durability of various edge insulation materials (Appendix A). Three of the nine specimens showed little change in condition after the 300-day period of installation. However, some fiber boards made from organic materials absorbed considerable moisture or deteriorated when placed in contact with the moist earth.

In another supplemental study (Appendix B) an analysis was made of the time lags involved in the heat transfer by conduction from the perimeter duct. Values of heat transfer lag and the time of response indicated that large lags occurred in the mass under the duct, and relatively small lags occurred at the floor surface. In spite of the large times of response, little difficulty in room-air temperature control is anticipated with a perimeter system utilizing a conventional room thermostat, because of the relatively large convection input from the registers.

**Acknowledgments**

This paper is a report of an investigation conducted in the Floor Slab Laboratory under the terms of a cooperative agreement between the *National Warm Air Heating and Air Conditioning Association* and the *Engineering Experiment Station of the University of Illinois.*

This paper includes material from the thesis completed under the direction of Prof. S. Konzo and submitted in partial fulfillment of the requirements for the degree of master of science in mechanical engineering by E. R. Archambeau, Jr. The assistance of Dr. B. T. Chao is acknowledged. These results will ultimately comprise part of a University of Illinois Engineering Experiment Station bulletin.

**References**

1. Measurements of Heat Losses from Slab Floors, by R. S. Dill, W. C. Robinson, and H. E. Robinson (*Building Materials Report BMS* 103, *National Bureau of Standards*, 1945).

2. Temperature and Heat Loss Characteristics of Concrete Floors Laid on the Ground, by H. D. Bareither, A. N. Fleming, and B. E. Alberty (*American Artisan*, Vol. 87, No. 3, March 1950).

3. Warm-Air Perimeter Heating, Part I, Heat Emitted from Floor Surface, by J. R. Jamieson, R. W. Roose, and S. Konzo (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, Vol. 23, July 1951, pp. 117-126).

4. Warm-Air Perimeter Heating, Part II, Temperature Drop in Ducts Embedded in Concrete Floors, by J. R. Jamieson, R. W. Roose, S. Konzo, and H. T. Gilkey (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, p. 119, this issue).

5. *Heat Transfer*, by Max Jakob, Vol. I, 1950 (John Wiley and Sons, Inc., New York, N.Y.).

6. Comparative Performance of Two Types of Warm-Air Perimeter Systems and Three Convection Systems, by M. E. Childs, R. W. Roose, H. T. Gilkey, and S. Konzo (*University of Illinois Engineering Experiment Station Bulletin* — in preparation).

## APPENDIX A
## Durability of Materials for Edge Insulation

The edge of insulation of concrete floor slabs usually consists of rigid insulation boards applied to the inner face of the foundation wall, either vertically or in an "L" shape under the slab. The edge insulation should have stable thermal properties which will endure for the life of the building. For this application the materials should be: (1) Sufficiently rigid to withstand the pressure exerted by the fluid concrete during the pouring operation; (2) Impervious to moisture; and (3) Impervious to decay and rot.

Some of the rigid-board insulation materials that are currently used as edge insulations are: fiberboards consisting of wood, cane, mineral wool, or glass fibers; corkboards which are coated or contain a large amount of asphalt; and cellular boards of glass, rubber, or polystyrene. Most of these materials possess sufficient rigidity for use as edge insulation but many are not resistant to moisture and decay.

A supplemental study of the durability of several edge insulation materials was conducted at the Floor Slab Laboratory. Nine different types of edge insulation were placed in a vertical position along the corridor wall of Room D, as shown in Fig. 1. Each specimen was embedded to a depth of 18 in. so that the upper 4 in. were exposed to concrete, the succeeding 4 in. were exposed to gravel, and the lower 10 in. were exposed to the soil. The moisture content of a soil sample taken at the time of installation was found to be 16 percent based upon the dry weight. The specimens were weighed and installed 24 hours prior to the pouring of the concrete floor of Room D. At the end of 300 days, the specimens were removed and weighed, and the condition of each specimen was recorded. The results of this study are given in Table 6. Fig. 10 shows six selected groups of materials studied. The test specimen is shown on the right side of each group, while an identical unused specimen of the same material is shown on the left side. Photographs of the corkboard (Sample 8) and of the cellular glass board (Sample 9) were not shown, since neither specimen showed any visible sign of change. Both materials seem well adapted for use as edge insulation. The asphalt enclosed glass fiberboard (Sample 6) gave minor evidence of change. Distinct moisture marks were noticeable on the remaining fiberboards (Samples 1, 2, 3, 4, 5, and 7), approximately 8 in. from the top, which were attributed to the marked difference between the moisture content of the soil and that of the gravel. No signs of deterioration were observed where the specimens were exposed to gravel or concrete. However, moisture absorption and deterioration of the materials were observed where they were exposed to the moist soil. Samples 1 and 2 deteriorated and were poorly adapted for this application. Although Samples 3, 4, 5, and 7, which were asphalt-coated or asphalt-impregnated fiberboards, absorbed some amount of moisture under test conditions, it was considered that their application could be materially improved by observing the following precautions:

1. The use of L type construction [Figs. 2(a) or 2(b)], which eliminates direct contact with the underlying soil, is recommended.
2. Sufficient drainage should be provided by the use of a layer of *coarse* gravel under the insulation.
3. A waterproof coating should be applied to both sides of the insulation.
4. The dampproofing membrane located over the gravel fill should be applied under the insulation.

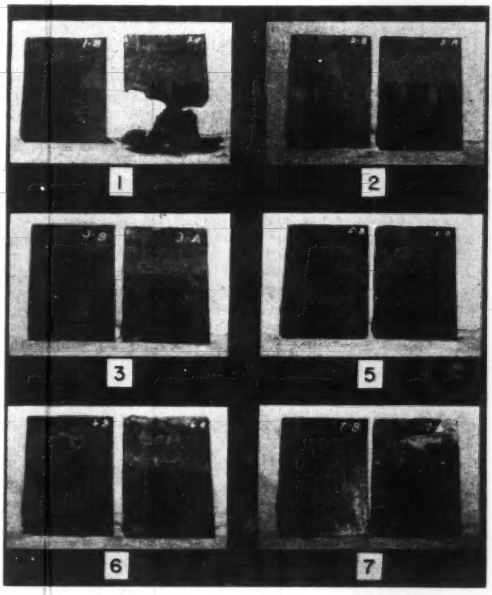



Fig. 10—Insulation materials used in durability study (*left* sample in each group is unused specimen; *right* — specimen after 300 day application)

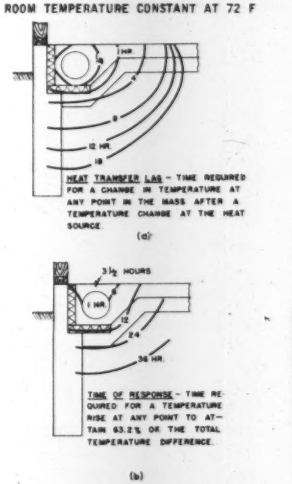

ROOM TEMPERATURE CONSTANT AT 72 F
1 HR
4
8
12 HR.
18
HEAT TRANSFER LAG – TIME REQUIRED FOR A CHANGE IN TEMPERATURE AT ANY POINT IN THE MASS AFTER A TEMPERATURE CHANGE AT THE HEAT SOURCE.
(a)
3½ HOURS
4
1 HR.
12
24
36 HR.
TIME OF RESPONSE – TIME REQUIRED FOR A TEMPERATURE RISE AT ANY POINT TO ATTAIN 63.2% OF THE TOTAL TEMPERATURE DIFFERENCE.
(b)

Fig. 11—Heat transfer lag and time of response

## APPENDIX B
## Heat Transfer Lag and Response of the Mass Surrounding the Perimeter Duct

When an element of a heating system such as an embedded duct is surrounded by a large mass, considerable time is required to heat the mass, which could result in a system having a *flywheel effect*.

The *heat transfer lag* at any point in the mass can be considered as the time required to detect a temperature change at the point, following a change in temperature at the heat source. For example, in the case of a perimeter duct the heat transfer lag at any point in the mass surrounding the duct is the time required for a sudden change in duct-air temperature to be reflected by a change in temperature at the point.

In order to determine the heat transfer lag, a perimeter duct-air temperature of 107 F and a duct-air velocity of 375 fpm were maintained for several weeks. The input to the electric furnace was suddenly doubled, while continuous readings were taken of the temperature of the mass surrounding the perimeter duct. The heat transfer lags as thus determined are shown in Fig. 11(a).

The heat transfer lag of the ground below the duct is large and of the order of 12 hours at a distance of 2 ft from the duct. The lag of the floor surface is a variable, having a minimum value of approximately 10 min at a point directly over the duct and increasing in magnitude with distance from the duct. The values shown in Fig. 11 were obtained with a constant room-air temperature of 72 F. Values for a case in which the room-air temperature is rising, as would occur during the heating period of a cold room, would probably be less than those given in Fig. 11(a). It should be realized that the heat transfer lags merely indicate when the *start* of the temperature rise will occur, but do not indicate the time required to approach a final steady-state temperature.

A better indication of the time required for the temperature rise to be substantial

Table 6—Durability of Materials for Edge Insulation

| Sample No. | Description | Thickness (inches) | Avg Density lb/cu ft | Conductivity at 70F as Rept'd by Mfr. | Weight (lb) Initial | Weight (lb) Final | Moisture Increase % | Final Condition of Lower 10 in. of Specimen |
|---|---|---|---|---|---|---|---|---|
| 1. | Cane fiberboard[a] for sheathing, painted asphalt coating | 25/32 | 19.0 | 0.35 | 1.74 | [b] | [b] | Very moist, badly deteriorated. |
| 2. | Wood fiberboard[a] for sheathing | 25/32 | 26.0 | 0.33 | 2.69 | 2.90 | [b] | Very moist, slight deterioration, some delamination. |
| 3. | Asphalt impregnated cane fiberboard for expansion joints | 1 | 28.0 | — | 3.47 | 3.71 | [b] | Moist throughout. |
| 4. | Asphalt impregnated cane fiberboard for expansion joints | 1 | 24.0 | — | 2.92 | 3.30 | 13 | Moist throughout. |
| 5. | Fiberboard for expansion joints, asphalt impregnated glass | 1 | 20.0 | 0.35 | 2.49 | 2.61 | 9 | Damp throughout. |
| 6. | Fiberboard, asphalt enclosed glass | 1 | 6.0 | 0.27 | 1.86 | 1.93 | 4 | Good. |
| 7. | Cane fiberboard for roof insulation | 1 | 19.0 | 0.33 | 2.39 | 2.87 | 20 | Very moist, some delamination. |
| 8. | Corkboard, coated with asphalt | 2 | 10.0 | 0.30 | 2.41 | [c] | [c] | Good. |
| 9. | Cellular board, glass | 2 | 10.0 | 0.42 | 2.47 | 2.50 | 1 | Good. |

[a]Not recommended by manufacturer for use as edge insulation, but is frequently installed by builder.
[b]Disintegration of specimen during test created unusually low and fictitious values (see Fig. 10).
[c]Some gravel adhered to coating of asphalt (applied hot) rendering an erroneous final weight.

and for the floor surface to become effective as a heating panel is provided by Fig. 11(b). The *time of response* of the mass surrounding the perimeter duct can be considered as 63.2 percent of the total time required for the temperature of the mass to change from its initial to its final value. The value of 63.2 percent was derived from Newton's law of cooling which states that the rate of temperature change of the mass is proportional to the difference in the final and instantaneous temperatures, or

$$dt/d\theta = (1/\lambda)\ (\mu - t) \quad \text{.....(B-1)}$$

*where*

$t$ = Instantaneous temperature, Fahrenheit.
$\theta$ = Instantaneous time, hours.
$\lambda$ = Lag coefficient, hours.
$\mu$ = Final temperature of the mass, Fahrenheit.

Equation (B-1) can be solved as a linear differential equation which results in,

$$t' = 1 - e^{-\theta/\lambda} \quad \text{.....(B-2)}$$

*where*

$t'$ = Instantaneous temperature expressed as a ratio of the difference in final and initial temperatures of the mass, or, $t' = (t - \mu_o)/(\mu - \mu_o)$
$\mu_o$ = Initial temperature of the mass, Fahrenheit.

The lag coefficient, $\lambda$, can be determined from a time-temperature curve for any point in the mass because when $\theta = \lambda$, then $t' = 0.632$. Thus, the lag coefficient is equal to the time required for a 63.2 percent change in temperature to occur. The values of $\lambda$ are shown in Fig. 11(b).

The impression might be obtained from the times shown in Fig. 11(b) that the flywheel effect of a warm-air perimeter heating system is so large that the system is unresponsive to sudden changes in heating demand. As indicated previously in Tables 4(b) and 5, however, the heat emission from the floor panel is a relatively small proportion of the total heat emission from a typical warm-air perimeter system equipped with registers. In other words, a substantial proportion of the heat loss from the house is offset by convection input to the rooms through the registers. Hence, in spite of the large times of response shown in Fig. 11(b), actual experience[6] in a home provided with a perimeter system and a conventional room thermostat has shown that little difficulty in the control of room-air temperatures occurred.

# *Summary of Chapter Meetings**

• *ATLANTA*—December 10, 1951. Members and guests met at Harris' Tea Room for a social hour at 6:00 p.m. and dinner at 7:00 p.m., after which the business meeting was called to order by Pres. E. K. Jamison. President Jamison presented W. M. Garrard with a past president's pin for 1950, and then presented the Chapter with a beautiful aluminum letter file box for the president's papers, in keeping with the tradition established by previous past presidents. A committee was appointed to count the ballots, and F. A. Player and J. G. Croley were elected member and alternate member, respectively, on the Chapters Conference Committee.

The election of the following officers for 1952 was then announced: *president*—F. A. Player; *vice president*—J. G. Croley; *secretary*—J. M. Lazenby; *treasurer*—T. A. Barrow, Jr.; and *board of governors*—E. K. Jamison and W. M. Garrard. After Mr. Jamison thanked the members and officers who served with him during the year, he installed the new officers. Attendance 56.

• *CENTRAL OHIO*—December 17, 1951. The meeting was called to order by Pres. R. S. Curl at the Grandview Inn, and the minutes of the November 5th meeting were read and approved. W. A. Schoonover, membership chairman, reported a total membership of 94, and also reported that new ways for increasing the membership were being considered. He said that suggestions from the membership would be welcome. President Curl and A. D. Bogen were elected member and alternate member, respectively, on the Chapters Conference Committee.

The speaker of the evening was Joseph Hill, project engineer of Surface Combustion Corp. Mr. Hill, who designed a special aircraft heater manufactured by his company, spoke on *Heating Military and Commercial Aircraft*. His talk presented many of the problems involved in the manufacture and design of aircraft heaters. Attendance 23. Attendance ratio 0.21.

• *CINCINNATI*—December 4, 1951. The meeting was called to order by Pres. J. J. Bechtol, and the minutes of the November meeting were read and approved. W. H. Junker reported on the status of the State building code revision, disclosing that six chapters have been finished. He also announced that a public hearing on the subject of suspended solids disposal would be held at City Hall on December 5. Pinkney Varble reported on the progress in plans for the Chapter's Christmas Party at the Hotel Alms, and President Bechtol advised that a table reservation should be made for the Cincinnati members for the banquet at the St. Louis Meeting. R. G. Anderson announced that the January meeting would feature a bus trip to the Armco International Corp. at Middletown, Ohio, and that the guest speaker would be George Bearer.

Dr. Ludeke of the University of Cincinnati gave an address on the various sources of energy and their adaptation to conventional heating systems, with particular emphasis placed on the possibility of the conversion of atomic energy as a source of energy. Attendance 25. Attendance ratio 0.20.

• *DELTA*—November 13, 1951. Pres. Theodore Offner called the meeting to order in the Trophy Room of the New Orleans Athletic Club, and members introduced themselves and their guests. The minutes of the October 9th meeting were read and

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

approved, and C. V. Bankston, treasurer, announced that a report had to be provided to the Society of all Chapter members in good standing. He requested that all local dues be paid before the December meeting. J. S. Burke and Walter Cooke were elected member and alternate member, respectively, on the Chapters Conference Committee.

G. C. Kerr introduced the speaker of the evening, W. B. Moses, Jr., owner, Engineering Sales Co., New Orleans, who gave a most interesting presentation on *The Rockies*. Attendance 27.

• *GOLDEN GATE*—November 1, 1951. Pres. T. J. Janes called the meeting to order in the Engineers' Club at 7:45 p.m. Members introduced themselves and their guests, and the minutes of the October 4 meeting were read and approved. T. J. White, program chairman, announced that the December meeting would be a Christmas party and that the speaker for the January meeting would be Ernest Spelten of the U. S. Weather Bureau.

A film on fishing and hunting furnished by the Pacific Gas and Electric Co. was then shown, followed by another on the development of steam boilers. The latter film was provided through the courtesy of the Babcock and Wilcox Co. Both pictures were thoroughly enjoyed by the membership. Attendance 88.

• *ILLINOIS*—December 10, 1951. Members and guests met for dinner in the Merchants and Manufacturers Club of the Merchandise Mart. Pres. G. W. Bornquist called the business meeting to order, and the report of the membership committee was given, and new members were introduced. Reports by the treasurer and the St. Louis meeting committee then followed.

The first speaker of the evening was P. J. Marschall, chief engineer for Abbott Laboratories, Chicago, Ill. Mr. Marschall began by stating that in industrial plants the unit cost (dollar per cfm or dollar per ton) has absolutely no value, because it depends entirely upon the specific application, hours of operation, and local conditions. He pointed out that in one department of an industrial plant, 4 percent increase in worker efficiency paid for the cost, amortization, and operating expense of the air conditioning system for that department. He added that, when the system was shut off, complaints came, not from personnel discomfort, but because of a decrease in efficiency in the non-air conditioned atmosphere.

W. A. Stahl, building superintendent of the Merchandise Mart, the largest office building in the world, was the second speaker. Mr. Stahl gave some interesting descriptions of air conditioning, heating and ventilating systems in the Merchandise Mart and several other buildings of various sizes and shapes in the Chicago area. He stated that air conditioning costs ran from $1.75 per sq ft and up in the Merchandise Mart, probably the lowest in the world because of the large interior cubical content in proportion to outside wall area. Attendance 113. Attendance ratio 0.23.

• *INDIANA*—October 26, 1951. The combined meeting of the Indiana Chapter with the Air Conditioning Council of Indianapolis was held in La Rue's Restaurant. Pres. F. C. Barton called the meeting to order and members and guests were introduced.

S. E. Fenstermaker, Sr., introduced the speaker of the evening, Prof. William T. Miller, well known figure in the heating and ventilating field. Professor Miller, of Purdue University, W. Lafayette, Ind., gave an interesting lecture and demonstration on *Principles of Combustion*. A lively question and answer period followed. Attendance 80.

• *INLAND EMPIRE*—October 8, 1951. The meeting was called to order by Pres. L. E. Marque and the minutes of the previous meeting were read and approved. Reports were given by H. A. Bickel for the membership committee, Max Tonn for the attendance committee, and by J. A. Doyle, the treasurer.

The speaker of the evening, Bert Harden, was introduced by P. J. Favre. Mr. Harden spoke on *Propane Gas*, and gave statistics on the Btu rating of propane as against oil. He added that, so far, coal still seems to be the cheapest. Attendance 24.

• *IOWA*—December 5, 1951. The meeting was held at the Memorial Union, Iowa State College, Ames, and was a joint gathering with the Central Iowa Section of the *American Society of Mechanical Engineers* and the *ASME* Student Branch at the College. Pres. C. H. McGuiness called the meeting to order following dinner, and introduced the officers present from the three groups, and welcomed the guests. There was no business meeting, and the reading of the minutes of the November meeting was postponed until the next meeting.

Following a brief intermission, the group reassembled in the Oak Room, and J. F. Downie Smith, Dean of Engineering, Iowa State College, gave a brief report on the recent *ASME* Convention.

The speaker of the evening, Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N.H., was introduced next. He gave an interesting talk on *Engineering with a Human Touch*. The highlight of Dean Seeley's talk was the description and demonstration of the equipment used in his physiological studies with respired air. Attendance 86. Attendance ratio 0.54.

• *KANSAS CITY*—December 3, 1951. Pres. C. W. Schumacher called the meeting to order in the Wishbone Restaurant, Kansas City, Mo., and members and guests gave their names and company affiliations. President Schumacher announced that, to stimulate the interest of the students at the University of Kansas Student Branch, a joint meeting with *ASME* and a research project at the University had been

suggested. D. M. Allen advised that J. Donald Kroeker, nominee for treasurer of the Society, and consulting engineer from Portland, Ore., would speak at the Kansas Engineers' meeting on December 10 at the Town House. W. A. Reichow, the program chairman, announced that Prof. S. Konzo of the Department of Mechanical Engineering, University of Illinois, would speak at the January meeting on the subject, *Comfort with Warm Air Heat*. The minutes of the November meeting and the treasurer's report were read and approved.

Mr. Reichow introduced Guy Marby and Charles Egan, both of Owens-Corning Fiberglas Corp., who gave an interesting presentation on the various qualities of glass fiber insulation. Attendance 70. Attendance ratio 0.31.

• *MEMPHIS*—November 12, 1951. Members and guests met in the King Cotton Hotel at 6:30 p.m. for dinner, which was followed by the welcoming and introduction of guests. H. H. Wilson, Chapter treasurer, submitted his report, and requested payment of all 1951-52 dues.

Pres. R. E. Larkin turned the meeting over to the meetings chairman, G. C. Burr, who presented the guest speaker, Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N. H. Dean Seeley spoke on the subject, *Engineering with a Human Touch*, and pointed out that the heating and ventilating engineer occupies a unique position. *He is a member of the only professional group dealing directly and intimately with people and human comfort*, Dean Seeley said. He then described and demonstrated the experiments which he conducted, using himself as subject, in his study of the properties of air within the human body. Following a discussion period, President Larkin thanked Dean Seeley on behalf of the Chapter. Attendance 41.

• *MIAMI VALLEY*—November 7, 1951. The meeting, which was called to order at 8:00 p.m. by Pres. C. D. Weaver, was preceded by a dinner at Suttmiller's Restaurant. The minutes of the previous meeting were approved as read, and reports were given by many of the officers and the committee chairmen.

The guest speaker of the evening was Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N.H., and president of the Society, who spoke on *Engineering with a Human Touch*. Dean Seeley opened his talk by stating that the heating and ventilating engineer is directly responsible for the development of the environment. As an example of the service the engineer performs in the public interest, he mentioned that, during the winter, the pounds of air conditioned per day is equal to one year's steel output.

Dean Seeley also discussed his own investigations on the effect of relative humidity on human comfort. From this study he found that the nasal passages are a humidifier from which moisture in the blood is transferred to the air by the mucous membrane in the nose. For personal comfort, therefore, it is advantageous to prevent too rapid a transfer of this moisture from the blood to the air. At a relative humidity above 40 percent, this drying out is minimized. Attendance 25.

• *MICHIGAN*—December 10, 1951. This was the third annual joint meeting of the Michigan Chapter with the Detroit sections of the *American Society of Mechanical Engineers* and the *American Society of Refrigerating Engineers*. Dinner was served at 6:30 in the Engineering Society of Detroit Building, and the meeting was formally opened by G. W. Akers, president of the Michigan Chapter of ASHVE, who made the introductions of those at the speaker's table. Fred Boddy, chairman of the *ASME* group, introduced the coffee speaker, Madeline C. Dinu, L.L.B., who presented an interesting talk on *Present Day Developments of State and Inter-State Aviation Laws*.

The speaker of the evening, Henry Sleik, vice president of W. B. Connor Engineering Corp., Danbury, Conn., was introduced by John Rehard, chairman of the *ASRE* group. Mr. Sleik spoke on *Odors — Their Nature, Cause and Control*. Mr. Sleik, who was intimately acquainted with the development of a unit for odor control through the use of activated carbon, gave an interesting address on a subject of equal interest to the members of all three organizations. Attendance 250.

• *MONTREAL*—December 10, 1951. Pres. J. G. Chenevert called the dinner meeting to order in the Berkeley Hotel at 6:15 p.m. Following dinner, the minutes of the November meeting were read and approved, and members and guests introduced themselves. President Chenevert then urged all members to attend the Society's 58th Annual Meeting in St. Louis, January 28-30. The speaker of the evening, Nolin Trudeau, vice president of Publicite Services Ltd., provided a very humorous presentation on the subject, *When Everybody is Wrong, Everybody is Right*.

The remainder of the evening was given over to entertainment, arranged by J. C. Hennesey, chairman of the entertainment committee for the Christmas party.

• *NEBRASKA*—December 4, 1951. The feature of the meeting was the talk given by the guest of the evening, Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N.H. Prior to his address, Dean Seeley extended greetings from the Society. He also invited all the members to attend the Society's Annual Meeting in St. Louis, and the forthcoming Semi-Annual Meeting in Spring Lake, N.J.

In speaking on his topic, *Engineering with a Human Touch*, Dean Seeley told of the research he had conducted on the effects of temperature and humidity variations on the nasal passage. He also displayed and demonstrated the equipment used in his experiments. Attendance 38.

• *NORTH CAROLINA*—December 11, 1951. Members and guests met for a social hour and dinner in the Selwyn Hotel, Charlotte, and the business meeting which followed was called to order by Pres. R. O. McGary. The minutes of the previous meeting were read and approved. The following officers were elected to serve for 1952: *president*— L. L. Vaughan; *vice president*—R. M. Warren, Jr.; *secretary-treasurer*—C. A. McKeeman; and *board of governors*—J. E. Hart and W. H. Reed.

President McGary introduced A. V. Hutchinson, executive secretary of the Society, who spoke on the work of the Society and the efforts expended toward providing the local Chapters with up-to-the-minute information on subjects of vital interest to the members through its publications and the Speakers Bureau.

A discussion followed on the advisability of dividing the Chapter into two sections, one with headquarters at Greensboro and the other with headquarters at Charlotte. On the basis of a mail survey and vote of the members present, it was decided to have the officers work out the details of creating a North and South Piedmont Chapter to succeed the North Carolina Chapter.

• *NORTHEASTERN OKLAHOMA*—December 11, 1951. Following dinner, which was served at 6:30 p.m. in Wynn's Restaurant, Pres. R. F. Shoemaker called the business meeting to order. The minutes of the previous meeting were read and approved, and the treasurer's report was submitted. V. W. Miles announced that a short course in Forced Warm Air was to be given at Oklahoma A & M College, January 17 through the 20. He added that this course is the first of its kind and is being sponsored by the School of Mechanical Engineering in cooperation with the *National Warm Air Heating and Air Conditioning Association*.

The speaker of the evening was James Cowles, corrosion engineer for Oklahoma Natural Gas Co., Tulsa, who spoke on *Cathodic Protection of Underground Pipes*. Mr. Cowles used actual pieces of equipment and display material, together with blackboard illustrations, making the presentation interesting and informative. Attendance 19. Attendance ratio 0.42.

• *NORTHEASTERN OKLAHOMA*—November 13, 1951. Members and guests met in Wynn's Restaurant for dinner at 6:30 p.m., which was followed by the business meeting called to order by Pres. R. F. Shoemaker. The minutes of the previous meeting were read and approved and members and guests introduced themselves. C. H. Dollmeyer, Jr., submitted the treasurer's report and W. R. Lee, in presenting the report of the program committee, announced that programs had been arranged through April, including a joint meeting with the Oklahoma Chapter in December at Stillwater.

A. D. Holmes gave the report of the nominating committee for 1952 officers as follows: *president*—C. H. Dollmeyer, Jr.; *vice president*— R. W. Winget; *secretary*—V. W. Miles; *treasurer*—Fred Colbert; and *board of governors*—R. F. Shoemaker, F. M. Thomas, and E. R. Cooke.

Mr. Lee introduced the speaker of the evening, E. B. Cover, branch manager, York Corp., Tulsa, Okla., who spoke on *Testing and Operation of Refrigeration Equipment*. Attendance 19. Attendance ratio 0.73.

• *OKLAHOMA*—November 12, 1951. Pres. J. H. Carnahan called the meeting to order at 8:00 p.m. in Beverly's Drive-In. The only item on the program was the address given by the guest speaker of the evening, J. R. Cowles, engineer, Oklahoma Natural Gas Co., Tulsa, Okla. Mr. Cowles spoke on *Corrosion in Underground Piping Systems*, explaining and demonstrating its cause and also prevention. He stated that corrosion, as we know it, is a galvanic action usually resulting from different metals, different soils, or from a lack of air. Mr. Cowles advised that corrosion can be reduced by means of anodes, rectifiers or thermocouples, and also by the use of insulating couplings and insulating coatings on pipe. Mr. Cowles drew an illustration of a simple piping system for a residence, showing the various methods of providing protection against corrosion in that piping system.

• *ONTARIO*—December 4, 1951. The meeting was called to order by Pres. William Philip, who introduced Walter Kallis, a new Chapter member and Einar Anderson, who transferred membership from the Manitoba Chapter. N. W. Kingsland spoke briefly regarding the forthcoming Annual Meeting in St. Louis.

The speaker of the evening was A. T. Jones, chief engineer, S. A. Armstrong, Ltd., Toronto, who spoke on *Selection of Circulating Pumps for Hot Water Heating Systems*. Mr. Jones' address was accompanied by slides. Attendance 108. Attendance ratio 0.43.

• *OREGON*—October 4, 1951. Pres. H. W. McKenzie called the meeting to order at 7:40 p.m. and self introduction of members and guests followed. The minutes of the previous meeting were read and approved, and the treasurer's report was submitted. Reports were also given by Dick Blankenship for the membership committee and E. E. Kelly for the student assistance committee. Helen Woolley, L. F. Miller and Faruk Konuk selected the following nominating committee: J. D. Kroeker, B. W. Farnes, W. B. Morrison, J. A. Freeman and R. C. Chewning.

K. H. Hanson introduced the speaker of the evening, Walter Hanthorn, local Chapter member, and engineer, Kleenair Furnace Co., Portland. Mr. Hanthorn gave an interesting presentation on perimeter heating, pointing out the advantages and limitations of air, steam and water when used in perimeter heat-

ing. The discussion period which followed indicated the members' great interest in the subject. Attendance 90. Attendance ratio 0.42.

• *PACIFIC NORTHWEST*—November 19, 1951. Following a social hour and dinner in the Engineers Club, the business meeting was called to order by Pres. R. M. Stern. A discussion on a meeting place indicated that the Engineers Club was the most suitable and that the Chapter, therefore, would continue to meet there.

W. B. Pride, program chairman, introduced Professor Nathaniel Glickman, assistant professor and medicine and research physiologist, University of Illinois Medical School, Chicago, the guest speaker, who spoke on *The Relationship of Man to his Physical Environment*. Professor Glickman illustrated his talk with slides, and judging from the active discussion period which followed, the members were deeply interested in the subject.

The meeting was then turned over to President Stern and a general discussion followed concerning the possibility of holding a meeting in Bremerton at the Naval Shipyard, either in January or February. Attendance 37. Attendance ratio 0.28.

• *PACIFIC NORTHWEST*—October 10, 1951. The first meeting of the season was held in the Golden Room of the Golden Goose Cafe, and following the social hour and dinner, Pres. R. M. Stern called the business meeting to order. Prof. H. M. Hendrickson of the University of Washington requested contributions of THE GUIDE 1950 for the University's Union Library.

The meeting was turned over to W. B. Pride, who introduced the speaker of the evening, Anson Blaker, assistant secretary-treasurer of the Boeing Airplane Co. Mr. Blaker gave an interesting presentation on the subject, *Practical Limits of Plant Expansion*. Attendance 55. Attendance ratio 0.51.

• *PHILADELPHIA*—December 13, 1951. Pres. E. K. Wagner called the meeting to order at 7:55 p.m. in the Engineers Club of Philadelphia. The minutes of the November meeting were read and approved and the treasurer's report was presented. The names of the nominating committee members were submitted and approved.

The feature of the evening was the address given by the speaker of the evening, Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N.H., and president of the Society. Dean Seeley spoke on *Engineering with a Human Touch*. Attendance 70.

• *PITTSBURGH*—December 17, 1951. Pres. W. D. Simpson called the meeting to order in Webster Hall, following dinner at 6:45 p.m., and the minutes of the November meeting were read and approved. B. B. Reilly reported for the program committee, while C. L. Benn submitted the treasurer's report.

Mr. Reilly introduced the speaker of the evening, B. R. Small, local chapter member, and staff engineer with Aluminum Company of America, Pittsburgh, who spoke on *Spot Cooling and Radiation Shielding in the Industry*. Mr. Small began by explaining the different methods of spot cooling the worker, indicating which methods were more efficient, and then went on to the methods of shielding man from the intense heat radiating from open hearth and heaters. Mr. Small used slides to demonstrate the principles brought out. Attendance 34.

• *ST. LOUIS*—December 4, 1951. Pres. L. L. Hamig called the meeting to order in the Westborough Country Club, and G. W. F. Myers, acting secretary for this meeting, read the minutes of the previous meeting, which were approved as read. The treasurer's report was submitted, and C. H. Burnap announced that the next meeting would be held at Town Hall on January 8 and that the speaker would be H. B. Nottage, research associate, ASHVE Research Laboratory, Cleveland. B. L. Evans, chairman of the St. Louis Committee on Arrangements, reported on the progress of meeting arrangements and gave an outline of the special events planned.

Mr. Burnap introduced the speaker of the evening, Dr. Eliud Garcia-Trĕvino, Consul of Mexico, who spoke on *Mexico Today*. A color sound film on Mexico was shown with the presentation, and both provided a good indication of Mexico's advancement in the last few years. Attendance 65.

• *SOUTHERN CALIFORNIA*—November 6, 1951. Members and guests met in the Carolina Pines Restaurant, Los Angeles, for dinner at 7:00 p.m. Pres. M. C. Greiner called the meeting to order and the treasurer's report was given, indicating that to date 96 members had paid their dues.

The speaker of the evening was Nathaniel Glickman, assistant professor and medicine and research physiologist, University of Illinois Medical School, Chicago, who spoke on *Physiological Reactions: Man's Adjustments to Ambient Air Conditions*. Professor Glickman illustrated his talk with slides, giving curves and graphs which showed test results obtained at the University. He stated that comfort is an important factor in man's life and tests showed that extreme air temperature conditions often cause sickness and simulate disease resulting in fainting of the persons tested. Subjects showed no difference in adaptability to changes in temperature in either summer or winter, and age and heat condition made no difference in adaptability. Attendance 72. Attendance ratio 0.27.

• *SOUTHWEST TEXAS*—November 20, 1951. The November meeting was in the form of a round table discussion on the subject, *Residential Air Conditioning* as it applies to Texas, with W. H. Luedecke acting

as moderator. The subject was the same as the discussion conducted at the September meeting, since so much was left uncovered at that time. Four new phases were introduced, and speakers and their individual subjects were: H. J. Faller—outside air in a heating system; Terry Small—extended plenum heating systems; Ray Woolrich—perimeter heating; and F. B. Frazee, who discussed remote units for both heating and cooling with medium transferred through piping instead of ducts, usually termed room units.

Prior to the discussion, the election of the following officers for 1952 was announced: *president*—W. E. Long; *vice president*—D. E. Locher; *secretary-treasurer*—L. H. Hornor, Jr.; and *board of governors*—Boone Crisp and R. W. Kotzebue. Attendance 35.

• *WESTERN MICHIGAN*—December 10, 1951. Following dinner, the business meeting was called to order by Pres. W. C. DeRoo, who welcomed the new members and the guests. He invited anyone interested in membership to contact one of the officers for information. An invitation was read from the Western Michigan Section of the *American Society of Refrigerating Engineers* to attend their monthly meetings.

President DeRoo introduced the speaker of the evening, C. W. Nessell, account executive, Minneapolis-Honeywell Regulator Co., Chicago, Ill., who spoke on the subject, *Newer Concepts of Warm Air Heating*. Mr. Nessell, who is the chairman of the Field Investigating Committee of the *National Warm Air Heating and Air Conditioning Association*, had first-hand information on the latest developments in heating a basementless structure. Among the points brought out was that ground preparation and proper insulation are important for a basementless structure, not only for a warm air perimeter heating system, but for any type of heating system. He stated that warm air is discharged through floor registers located under the windows about 8 in. out from the wall and the return air is taken from the ceiling or high side wall grilles located on the inside walls. The best way to heat a house with a crawl space is to discharge all of the warm air into the crawl space and let it enter the room through floor registers located under the windows. Attendance 117. Attendance ratio 0.18.

## STUDENT BRANCHES

• *OKLAHOMA A & M*—November 29, 1951. Pres. O. A. Brynie called the meeting to order at 7:00 p.m. in the Engineering Building, and the minutes of the previous meeting were read and approved. An announcement was made that H. S. Shafer of the Oklahoma Chapter had made arrangements for a field trip to a television studio in Oklahoma City on December 4. S. N. Cohen brought up the question concerning what project the Student Branch could exhibit at the Annual Engineering Open House, and suggested possibly making a model ice plant from glass tubing.

The remainder of the meeting was devoted to a discussion of the catalogs sent to the Student Branch by L. L. Arbuckle of Bell & Gossett, Morton Grove, Ill. The catalogs contained excellent engineering data and the students found them useful in design problems. Attendance 8.

• *PURDUE UNIVERSITY*—December 13, 1951. Melvin Kalfus called the meeting to order in the Mechanical Engineering Building, and the first order of business was the reading and approval of the minutes of the last meeting. The following students volunteered to work on projects to represent the Student Branch at the Engineers Open House: W. C. Cheek—panel radiant heating; P. C. Conway—wall condensation; Melvin Kalfus—solar heat; D. H. Mays—vapor demonstration; R. O. Bement—radiant cooling; and N. J. Kirch and R. O. Bement—air distribution.

Mr. Kalfus then introduced the speaker of the evening, Henry Sleik, vice president of W. B. Connor Engineering Co., Danbury, Conn., who spoke on *Air Purification*, giving a history of odors, their causes and cures. Mr. Sleik's talk was illustrated with slides. Attendance 26. Attendance ratio 0.78.

• *PURDUE UNIVERSITY*—November 28, 1951. R. O. Bement, vice chairman of the executive committee, called the meeting to order at 7:30 p.m. in the Mechanical Engineering Building. The minutes of the previous meeting were read and approved with a slight correction.

N. J. Kirch, chairman of the executive committee, introduced the speaker of the evening, S. E. Fenstermaker of S. E. Fenstermaker & Co., Indianapolis, who spoke on *Why Didn't Someone Tell Me These Things?*, or, specifically, the problems of the heating and ventilating sales engineer. Mr. Fenstermaker divided his talk into the following three sub-headings: (1) sales, (2) problem of design — space and cost, and (3) operational or service problems. He also told of several interesting problems he had encountered as a sales engineer. Attendance 16. Attendance ratio 0.65.

• *UNIVERSITY OF TORONTO*—December 17, 1951. Prof. F. G. Ewens called the meeting to order in the Mechanical Engineering Building of the University. The members present approved the election of J. A. Slemin as president and unanimously elected T. O. Smith as secretary. At the suggestion of Professor Ewens, the election of a vice president was deferred until the spring term when it was expected there would be a larger representation from the third year students.

Professor Ewens introduced W. E. Rootham, W. E. Baldwin, and E. R. V. Wilbee, graduates of the 1949, 1950 and 1951 classes, respectively. Mr. Rootham, of the Toronto office of Johnson Temperature Regulating Company of Canada, Ltd., discussed his duties as control sales engineer and told of the many problems that the young sales engineer may encounter.

Mr. Baldwin, of the Toronto office of Canadian Sirocco Company, Ltd., related some of his experiences in entering into the field of fans and air conditioning equipment as a sales engineer. He also demonstrated the operation of fluid drives by means of a motorized model. Mr. Wilbee, of the architectural firm of J. B. Parkin and Associates, discussed the nature of his work and also the field available for engineers as mechanical consultants with large architectural organizations.

G. B. Playfair, general manager, Johnson Temperature Regulating Company of Canada, Ltd., Ontario, showed a film demonstrating the operation of pneumatic temperature controls for valves and dampers. Attendance 16.

# *Candidates for Membership*

The Society's By-Laws require that all applications for membership or advancement are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society, or mailed to all members. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall confirm the election of the proposed Candidate for membership. During the past month, there have been 114 applications for membership, including 22 student applications and 3 reinstatements; in addition 13 advancements have been received. The names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by February 29, 1952, these candidates will be voted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

AMIDON, C. W., Jr. Engr. & Estimator, Nebraska Sheet Metal & Roofing Contractors, Inc., Omaha, Nebr. REFERENCES: J. S. Latenser, K. E. Martin, M. J. Olson, M. K. Rush.

ARBUCKLE, L. L., Mgr., Refrigeration Div., Bell & Gossett Co., Morton Grove, Ill. REFERENCES: G. W. Bornquist, R. E. Moore, Oslin Nation, E. E. Scott.

ARNOLD, B. G., Partner & Sales Engr., Arnold-Rippey Co., Houston, Tex. REFERENCES: G. J. Collins, J. W. Holland, R. J. Salinger, R. F. Taylor.

AUGUR, J. M., Partner, Augur, Jones, & Green, West Hartford, Conn. REFERENCES: R. C. Atherton, A. G. Dixon, C. J. Gaspar, W. F. Peters.

BARRETT, J. W., Mech. Engr., Guy B. Panero, Engineers, New York, N. Y. REFERENCES: T. Crowe*, F. Freedner*, Herbert Hecht, E. Smiddy*.

BEAN, F. E., Supt. & Estimator, J. F. Conway Heating & Plumbing, Syracuse, N. Y. REFERENCES: H. K. Ormsby, P. D. Robson, O. A. Warren, C. F. Woese.

BENKOVITZ, MORRIS, Vice Pres., Turner-McCoy Mech. Contractors, North Little Rock, Ark. REFERENCES: O. W. Armspach, R. E. Blaylock, L. L. Landauer, E. N. Pettit, Jr.

*Non-Member

BIRGER, E. E., Application Engr., Carrier Corp., New York, N. Y. REFERENCES: O. W. Armspach, J. H. Carpenter, H. S. Johnson, R. H. Leveridge.

BLANCHARD, E. E., Sales Engr., J. M. O'Connor Co., Oklahoma City, Okla. REFERENCES: J. H. Carnahan, W. J. Collins, Jr., J. H. Spaan, R. W. Winget.

BRINKERHOFF, H. A., Field Supt., Capitol Plumbing & Heating Co., North Little Rock, Ark. REFERENCES: J. L. Brown, A. G. Crothers, E. C. Dean, W. J. Franklin.

BROERSMA, W. K., Sales Engr., Powers Regulator Co., Baltimore, Md. REFERENCES: W. I. Collier, W. H. Kruger, III, D. A. MacWatt, E. K. Wagner.

BROWN, J. L., Owner, J. L. Brown Sales Co., Little Rock, Ark. REFERENCES: Morris Benkovitz*, R. E. Blaylock, Maury Hughes, Jr., E. N. Pettit, Jr.

BROWN, V. R., House Heating Engr., Lone Star Gas Co., Ft. Worth, Tex. REFERENCES: P. V. Barmann, E. J. Hatzenbuehler, Oslin Nation, J. L. Tye.

BURNS, C. S., Estimating, John Patton & Son, Little Rock, Ark. REFERENCES: R. E. Blaylock, R. E. Larkin, E. N. Pettit, Jr., W. E. Thorpe.

CARTOLANO, LAWRENCE, Engr., Mainco Air Conditioning & Refrigeration Corp., New York, N.Y. REFERENCES: J. R. Duncan, F. A. Fideli, Sherman Loud, C. P. Ruggiero.

CHRISTMAN, H. H., Jr. Engr., Carrier Corp., Syracuse, N.Y. REFERENCES: L. N. Brown*, D. L. Howard, B. P. Morabito*, J. F. Schmidt.

CLARK, R. E., Sales Engr., Iron Fireman Sales Corp., Washington, D.C. REFERENCES: P. A. Croney, L. T. Davis, H. K. Kugel, W. H. Littleford.

COOK, G. M., Asst. Engr., Blaylock & Zander, Cons. Engrs., Little Rock, Ark. REFERENCES: R. E. Blaylock, Herman Cumnock, E. C. Dean, E. N. Pettit, Jr.

COPLIN, J. L., JR., Mgr., Little Rock Office, A. W. Johnson Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, W. J. Franklin, Maury Hughes, Jr., E. N. Pettit, Jr.

CORZATT, P. P., Sales Engr., The Wm. Powell Valve Co., Cincinnati, Ohio. REFERENCES: C. T. Doudican, M. J. Gibbons, Jr., Jack Groeniger, Joseph Zellak.

COTTON, O. E., Secretary-Treasurer, Roland M. Cotton Co., Indianapolis, Ind. REFERENCES: I. W. Cotton, Stanley Hague*, J. T. Hardin, J. W. Jackson.

CROTHERS, A. G., Manufacturer's Repr., Engineering Service, Little Rock, Ark. REFERENCES: R. E. Blaylock, E. C. Dean, W. J. Franklin, E. N. Pettit, Jr.

DANIEL, E. L., Owner & Mgr., Capitol Plumbing & Heating Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, L. L. Landauer, E. N. Pettit, Jr., J. A. Scott*.

DAWSON, R. M., Factory Repr., United States Air Conditioning Corp., San Antonio, Tex. REFERENCES: T. P. Christman, Boone Crisp, J. G. Hopping, L. H. Hornor, Jr.

DIEHL, J. A., Owner, John A. Diehl Co., Cincinnati, Ohio. REFERENCES: F. J. Bottenhorn, III, A. W. Edwards, I. G. Edwards, G. R. Murphy.

ELLSTROM, J. R., Owner, John R. Ellstrom and Associates, Sellersville, Pa. REFERENCES: A. D. Brandt, R. L. Schlein, Ernest Szekely, E. S. Wilkins.

ERDEI, J. J., Mgr., Air Conditioning, Watersteam, Buenos Aires, Argentina. REFERENCES: Reidar Gundersen, A. R. Jalles, J. T. Lang, David Levin*.

EVINS, J. B., Engr., Carne Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, R. L. Larkin, T. J. O'Brien, E. N. Pettit, Jr.

FARROW, EVERETT, Owner, Farrow Plumbing and Heating, Elmore, Minn. REFERENCES: R. H. Lee, R. H. Lindgren, W. A. Swenberg, W. T. Swingle.

FERRARI, F. J., Branch Mgr., Messrs. Matthew Hall & Co., Ltd., London, England. REFERENCES: George Allen*, P. D. Doulton*, H. L. Egerton, S. Kindler.

FLEISCHER, G. A., Sales Engr., Carrier Corp., Detroit, Mich. REFERENCES: W. A. Brown, J. B. Olivieri, Albert Petronis, E. M. Tennant.

FONTANA, J. C., Chief Engr., Thermal Engineering Corp., Houston, Tex. REFERENCES: J. B. Buckley, G. D. Hines, J. A. Poole, O. G. Rivoire.

FRASER, W. D., Heating Engr., Moody and Moore, Architects, Winnipeg, Man., Canada. REFERENCES: R. L. Kent, D. F. Michie, R. E. Moore, D. S. Swain.

GAZLAY, J. H., Sales Engr., American Coal Burner Co., Chicago, Ill. REFERENCES: M. J. Bamond, T. V. Johnson, W. G. Pennington, G. V. Zintel.

GEORGE, WILFRED, Engr., Boeing Airplane Co., Seattle, Wash. REFERENCES: E. H. Langdon, J. A. MacDonald, K. H. Norby, W. B. Pride.

*Non-Member

GOLDSTEIN, E. L., Mfg. Repr., Little Rock, Ark. REFERENCES: R. E. Blaylock, R. E. Larkin, T. J. O'Brien, E. N. Pettit, Jr.

GOODDIE, J. J., Sales Repr., C. A. Dunham Co., Ltd., Ottawa, Ont., Canada. REFERENCES: M. C. Bailey, Ernest Fox, G. A. Gray, M. W. Shears.

GRANDERSON, LUTHER, JR., Asst. Mgr., Central Tin Shop, Pine Bluff, Ark. REFERENCES: E. H. Langdon, J. A. MacDonald, K. H. Norby, W. B. Pride.

GRANDERSON, LUTHER, SR., Owner, Central Tin Shop, Pine Bluff, Ark. REFERENCES: R. E. Blaylock, E. C. Dean, G. S. Veith, M. P. Veith.

GRANT, J. E., Factory Agent, Standard Chemicals, Inc., New Britain, Conn. REFERENCES: T. L. Arnold, A. R. LeVasseur, R. W. Sidbury, C. E. Weisner.

GRANT, W. H. D., Treas., Ozark Insulation Co., Inc., Little Rock, Ark. REFERENCES: M. Benkovitz*, A. T. Bevil, R. H. Hoshall, Larry Kelley*.

GREENOUGH, L. J., Ottawa Repr., The James Robertson Co., Ltd., Montreal, Que., Canada. REFERENCES: Valmore Dumont, J. A. Morris, E. Shaner*, Bernard Stotesbury.

GUNTHORPE, C. E., Sales Mgr., Bryant Heating and Equipment Co., Atlanta, Ga. REFERENCES: C. B. Cole, G. B. Hightower, P. A. Talmadge*, M. W. Wise.

HIMSTEDT, H. H., Owner, Himstedt Supply Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, H. T. Cumnock, W. J. Franklin, E. N. Pettit, Jr.

HOLDER, C. P., Mgr., Refrn. Supplies Dept., N. O. Nelson Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, H. T. Cumnock, W. J. Franklin, E. N. Pettit, Jr.

HUEGELY, J. H., Design Engr., Columbus Heating & Ventilating Co., Columbus, Ohio. REFERENCES: T. H. Bell, J. A. Guy, W. A. Schoonover, T. R. Walker.

HYDE, W. S., Asst. Industrial Engr., Arkansas Louisiana Gas Co., Little Rock, Ark. REFERENCES: S. W. Beaty, R. E. Blaylock, Maury Hughes, Jr., E. N. Pettit, Jr.

JAYE, THEODORE, Sales Engr., Minneapolis-Honeywell Regulator Co., Milwaukee, Wis. REFERENCES: R. A. Lingen, C. J. Reuschlein, R. H. Schulz, H. W. Snyder.

JOHNSON, W. R., Sales Engr., Federal Supply Co., Oklahoma City, Okla. REFERENCES: M. B. Baldwin*, W. W. Frankfurt, W. A. Landers*, W. B. Loeffler.

KAPLAN, BERNARD, Plumbing Designer, Voorhees, Walker, Foley & Smith, New York, N.Y. REFERENCES: W. A. DiGiacomo, Norman Goldberg, L. H. Monroe, Philip Schatkun.

KELLER, H. M., Customer Relations, Arkansas Louisiana Gas Co., Little Rock, Ark. REFERENCES: S. W. Beaty, R. E. Blaylock, J. I. Menefee, E. N. Pettit, Jr.

KERSHAW, C. A., Combustion Engr., & Consultant, Gabriel Fabrication & Boiler Co., Portland, Ore. REFERENCES: H. O. Erwin*, R. C. Fitch*, C. C. Kershaw*, S. C. Schwarz*.

KINGSTON, E. B., Designer, Kingston & Salmon, Ltd., Prescott, Ont., Canada. REFERENCES: G. A. Gray, Arthur Nearingburg, W. B. Pennock, W. J. Robinson.

KUELLMER, V. A., Sales Repr. Allied Construction Equipment Co. REFERENCES: B. P. Fisher, M. E. Linn, D. M. Mills, R. A. Molnari.

LEWIS, J. C., Mgr., J. C. Lewis Co., Little Rock, Ark. REFERENCES: B. R. Anderson*, Harry P. Eichin*, W. J. Oonk, George Wittenberg*.

LEWIS, JIM C., Sales Repr., J. C. Lewis Co., Little Rock, Ark. REFERENCES: C. E. Blome, John Cullinane*, C. M. Wilson, George Wittenberg, Sr.*

MACLEAN, J. K., Agent, Tuttle & Bailey Co., Providence, R. I. REFERENCES: R. S. Brenton, T. S. Hart, W. H. Romer, R. E. Wilkinson.

MAINVILLE, L. W., Design Engr., Guy Belanger, Montreal, Que., Canada. REFERENCES: G. L. Ballantyne, J. B. Flanagan, J. G. Le Francois, G. E. Smith.

MARCUM, E. C., Sales Engr., Southern Heater Co., New Orleans, La. REFERENCES: R. E. Blaylock, Herman Cumnock, E. C. Dean, W. J. Franklin.

MARGOLIES, A. E., Heating-Sales Engr., F. & M. Plumbing Supply Co., New York, N. Y. REFERENCES: R. W. Everett*, Jack Kreiner, J. P. Lyon, M. M. Pizer.

MARTIG, H. J., 2nd Vice-Pres., J. H. Martig, Inc., Omaha, Nebr. REFER-

ENCES: S. W. Black, K. E. Martin, B. G. Peterson, Verne Simmonds.

McCAUGHEY, J. H., Draftsman & Mgr., Guy Belanger, Ottawa, Ont., Canada. REFERENCES: Guy Belanger*, J. G. Chenevert, J. L. Neilans, W. B. Pennock.

McNALLY, G. L., Secretary, C. L. Mahoney Co., Kalamazoo, Mich. REFERENCES: W. W. Bradfield, Jr., J. J. Mahoney, R. W. Mangrum, R. W. Wilson.

McSHANE, H. R., Supt., L. L. McConachie Co., Detroit, Mich. REFERENCES: L. A. Burch, E. F. Glanz, D. L. McConachie, G. Q. McNamara.

MILLER, C. H., General Mgr. & Owner, Refrigeration & Electric Supply Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, Herman Cumnock, E. C. Dean, W. J. Franklin.

MILLER, J. S., Engr., Richard M. Stern, Cons. Engr., Seattle, Wash. REFERENCES: Lincoln Bouillon, R. M. Stern, C. L. Timpe, R. M. Towne.

MOSS, L. B., JR., Chief Engr., D. M. Michie Co., Houston, Tex. REFERENCES: C. A. McKinney, D. M. Robinson, Louis Snedden*, R. L. Telford.*

MOTT, BROCK, Owner, Brock Mott Company, Houston, Tex. REFERENCES: R. O. Ayres, R. M. Carr*, R. B. Johnson, A. D. Payne.*

MULLINS, J. E., Owner, Mullins Engineering Co., Little Rock, Ark. REFERENCES: R. E. Blaylock, Herman Cumnock, W. J. Franklin, E. N. Pettit, Jr.

NASS, A. F., JR., Designer, McGinness, Smith & McGinness Co., Pittsburgh, Pa. REFERENCES: A. F. Nass, E. H. Riesmeyer, Jr., C. H. Schneider, W. D. Simpson.

NEWLOVE, JACK, Sales Engr., Minneapolis-Honeywell Regulator Co., Detroit, Mich. REFERENCES: C. F. Mally, Albert Petronis, E. M. Tennant, K. J. Wagner.

PARSONS, D. H., Heating Engr., Portland Gas & Coke Co., Portland, Ore. REFERENCES: E. E. Carroll, S. S. Day, A. E. Finlay, L. O. Howlett.

POWELL, F. A., Estimator, Forget-Powell Co., Montreal, Que., Canada. REFERENCES: T. G. Anglin, J. B. Dykes, B. J. Horsbugh, R. A. Standring.

POWELL, J. H., Sales Engr., Eggelhof Engineers, Inc., San Antonio, Tex. REFERENCES: F. C. Benham, Jr., L. H. Hornor, Jr., L. S. Pawkett, G. R. Rhine.

*Non-Member

## John R. Allen Memorial Library

The ASHVE Committee on Research gratefully acknowledges the following gift to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

*Building Insulation*, by Paul D. Close, fourth edition (American Technical Society, Chicago, 1951). Gift of the American Technical Society.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

RADO, L. G., Mech. Engr., U. S. Naval Shipyard, Brooklyn, N. Y. REFERENCES: Sidney Fratkin*, C. C. Nicholson*, W. T. Olszewski*, Theodore Raynis.

REED, W. J., Sales Engr., J. E. Hurston, Manufacturers' Repr., Little Rock, Ark. REFERENCES: R. E. Blaylock, E. C. Dean, Maury Hughes, Jr., E. N. Pettit, Jr.

ROBERTS, C. P., Chief Engr., Voorhees, Walker, Foley & Smith, New York, N. Y. REFERENCES: Albert Giannini, P. B. Gordon, J. B. Hewett, A. F. Hinrichsen.

ROSENBERG, NORMAN, Sales Engr., Southern Furnace and Supply Co., Houston, Tex. REFERENCES: G. W. Brown, B. P. Fisher, J. W. Holland, R. J. Speich.

ROSS, E. R., Owner, Edward R. Ross, Consulting Engrs., Indianapolis, Ind. REFERENCES: M. W. Bishop, W. W. Grear, W. T. Miller, G. B. Rottman.

ST. CYR, W. D., President & Owner, Wilfrid D. St. Cyr Co., Montreal, Que., Canada. REFERENCES: Robert Clapperton, J. P. Fitzsimmons, W. S. Murray, Wellie St. Cyr.

SHOCK, C. H., Draftsman Engr., Dept. of National Defense, Ottawa, Ont., Canada. REFERENCES: B. J. Horsburgh, G. L. Ostiguy, W. J. Robinson, Bernard Stotesbury.

THOMAS, S. A., Sales Engr., Johnson Service Co., Seattle, Wash. REFERENCES: R. R. Kirkwood, C. A. Pangborn, S. D. Peterson, W. B. Pride.

TOMPKINS, G. W., Heating Supt., Arkansas Mechanical Contractors, North Little Rock, Ark. REFERENCES: R. E. Blaylock, W. J. Franklin, E. N. Pettit, Jr., W. E. Thorpe.

TURNER, T. W., Engr., Capitol Plumbing & Heating Co., North Little Rock, Ark. REFERENCES: R. D. Elgin*, W. J. Franklin, Maury Hughes, Jr., E. N. Pettit, Jr.

UHL, J. B., JR., Chief Engr., Gas Dept., American Radiator & Standard Sanitary Corp. REFERENCES: F. E. Hanson, C. W. Holtman, L. L. Smith, Herwart Werker.

WILEY, T. R., Sales Engr., The Rush Company, Omaha, Nebr. REFERENCES: K. E. Martin, M. K. Rush, Verne Simmonds, O. J. Smith.

WILLIAMS, R. D., Chief Engr., Tennessee Gas Building Corp., Houston, Tex. REFERENCES: J. R. Franklin, Lacy Key, Jr., R. K. Ritner, R. J. Salinger.

WOHRER, H. F., Chief Test Engr., Johnson Service Company, Milwaukee, Wis. REFERENCES: J. A. Cutler, M. M. Herrick, C. A. Otto, J. R. Vernon.

WOLF, T. A., Owner, Thomas Wolf Co., San Antonio, Texas. REFERENCES: L. C. Ferrell, J. G. Hopping, L. H. Hornor, Jr., L. S. Pawkett.

### STUDENTS

OKLAHOMA A. & M. COLLEGE, Stillwater, Okla. CERTIFIED BY: R. R. Irwin*.
MAHAMOUD, M. M.
RICE, H. G.

OREGON STATE COLLEGE, Corvallis, Ore. CERTIFIED BY: A. D. Hughes*.
BERTINCHAMPS, F. J.
BLAIR, D. W.
FREUDMAN, ERNEST
JACKSON, R. J.
KERR, A. W.
MERKLIN, E. O.
NOAKES, J. C.
PETERSON, R. W.
ROSCOE, J. R.

PURDUE UNIVERSITY, W. Lafayette, Ind. CERTIFIED BY: W. T. Miller.

ADAMS, M. L. LUTZ, T. A.

AYMONIN, J. A. WESTLUND, R. E.

FRANCEL, J. P., JR.

UNIVERSITY OF TORONTO, Toronto, Ont., Canada. CERTIFIED BY: F. G. Ewens.

LE FAIVE, M. B. SMITH, L. W.

ROE, W. G. SMITH, T. O.

SCOTT, R. J. I. SQUIRES, A. D.

## REINSTATEMENTS

GLANZER, C. J., Sales Engr., Esch-Condit, Inc., Houston, Tex. REFERENCES: R. S. Dill, R. S. Farr, L. E. Slawson, Cyril Tasker.

HYDE, D. F., Vice Pres., Becker Marsden Co., St. Louis, Mo. REFERENCES: M. F. Carlock, E. E. Carlson, C. E. Hartwein, L. W. Moon.

PETTIT, K. A., (Advancement), Partner, Pettit & Pettit, Little Rock, Ark. REFERENCES: R. E. Blaylock, W. J. Franklin, E. N. Pettit, A. H. Scott.

## ADVANCEMENTS

BRAUN, C. R., JR., Mechanical Engr., J. Gordon Turnbull, Inc., Cleveland, Ohio. REFERENCES: Wallace Adache*, B. E. Colwell, S. R. Guilbert, C. M. Humphreys.

DAULONG, E. J., Sales Engr., Catlett Engineers, Dallas, Tex. REFERENCES: W. A. Catlett, G. A. Linskie, D. L. Moody, J. A. Ray.

GAY, N. R., Associate Prof., Cornell University, Ithaca, N.Y. REFERENCES: B. J. Conta*, C. O. Mackey, D. G. Shepherd*, R. D. Tutt.

HAYES, G. J., Secretary and Engr., Hayes Brothers, Inc., Indianapolis, Ind. REFERENCES: F. C. Barton, S. E. Fenstermaker, W. F. Freije, G. O. Jackson.

LASHLEY, W. L., JR., Owner, W. L. Lashley Co., Houston, Tex. REFERENCES: E. G. Floeter, I. A. Naman, Frank Niel, R. J. Salinger.

OSTIGUY, G. L., Mech. Engr., Royal Canadian Air Force, Ottawa, Ont., Canada. REFERENCES: B. J. Horsburgh, W. J. Robinson, Bernard Stotesbury, H. M. Treleaven.

PETERSON, K. P., Mgr., Heating Dept., Leighton Supply Co., Des Moines, Ia. REFERENCES: I. R. Johnson, W. E. Petersen, R. L. Pound, B. A. Schwirtz.

RANDALL, R. D., Partner-Owner, D. T. Randall & Co., Detroit, Mich. REFERENCES: G. W. Akers, D. S. Falk, R. H. Oberschulte, W. H. Old.

REIS, ROBERT, Chief Mech. Engr., Wigton Abbott Corp., Plainfield, N. J. REFERENCES: R. C. Hodges*, E. C. Lang, G. C. Norman, P. H. Werner.

REYNOLDS, J. C., Application Engr., Westinghouse Electric Corp., Sturtevant Div., Pittsburgh, Pa. REFERENCES: E. C. Hack, H. K. Jennings, H. W. Rainey, Jr., J. N. Riley.

RIEHL, W. L., Sales Engineering Repr., Ernest C. Lundt Inc., Little Falls, N. J. REFERENCES: R. A. Baker, R. L. Manier, D. L. Mills, L. E. La Row.

THOMAN, E. O., Pres., Industries Engineering Corp., New Orleans, La. REFERENCES: J. S. Burke, L. V. Busenlener, Walter Cooke, R. B. Guest.

TOULOUKIAN, Y. S., Asst. Prof. Mech. Engrg., School of Mech. Engrg., Purdue University, Lafayette, Ind. REFERENCES: A. L. Hesselschwerdt, Jr., James Holt, W. T. Miller, H. G. Venemann*.

## OBITUARIES

### WILLIAM W. ALLEN
**Jacksonville, Fla.**

William W. Allen, chairman of the board of the American Coolaire Corp., died November 24 at New York's Memorial Hospital, where he had undergone an operation several days before. He was 54 years old and a resident of Jacksonville, Fla.

Mr. Allen was born in McIntosh, Fla., December 6, 1896. He served as a Lieutenant in World War I and was graduated from Alabama Polytechnic Institute in 1918 with a degree in electrical engineering.

Mr. Allen located in Jacksonville in 1925 and was active in the lumber and building business for several years after his arrival there. He was among the founders of the Coolaire Corp. and served as president of the firm until being elevated to the chairmanship of the board in 1949.

An active Shriner, he was a member of Morocco Temple and was a 32nd degree Mason. He was a member of the Royal Order of Jesters, the Florida Yacht Club, the Timuquana Club, and the *National Association of Manufacturers*.

He is survived by his wife, Florrie Graves Allen; two sons, William W. Jr., and John S.; and two grandchildren. The Officers and Council extend sincere sympathy.

•

### ROBERT E. BREISCH
**Santa Monica, Calif.**

Robert E. Breisch, 33, a member of the Society, was killed in an explosion of a curing oven November 5 at the Douglas Aircraft Plant in Bell, Calif. Mr. Breisch, who was an engineer with Douglas, was one of four employees killed in the blast.

Born on July 19, 1918, in Casper, Wyo., Mr. Breisch attended primary schools in Tulsa, Okla. He returned to Wyoming to study mechanical engineering at the University of Wyoming, but his classes were interrupted by the advent of World War II.

After wartime service with the United States Army in the Philippines, he resumed his studies at Wyoming and was graduated in 1947 with a B.S. degree in mechanical engineering. Following his graduation, he was connected for a short time with the Ralph Parsons Engineering Co., Los Angeles. He had been with Douglas for about six months when the accident occurred.

In addition to his work with the aircraft firm, he maintained a consulting engineering office in Santa Monica.

Mr. Breisch was a member of the *California Society of Professional Engineers*, the Santa Monica Rotary Club, and the Santa Monica Junior Chamber of Commerce. He also had served on the Santa Monica Community Chest and was a member of the Masonic Lodge in Carroll, Ia.

He is survived by his wife, Betty Jo; and a son, Richard, age 3; his parents, Mr. and Mrs. E. R. Breisch; a brother, Lt. William Breisch, USAF; a sister, Mrs. E. R. Squires, Jr.; and his grandfather, E. R. Breisch, Sr. The Officers and Council extend their sympathy to all the members of Mr. Breisch's family.

•

### WHARTON CLAY
**New York, N.Y.**

Wharton Clay, 72, secretary-treasurer of the Perlite Institute, trade association of building material manufacturers, died January 2 in New York City.

Born in Chicago, Mr. Clay was graduated from the University of Illinois School of Architectural Engineering. He was formerly secretary-treasurer of the *National Mineral Wool Association* and commissioner of the *Metal Lath Manufacturers Association*. He wrote articles on housing economics for trade and professional publications.

In the early 1930's, Mr. Clay acted as an adviser in the establishment of the Federal Housing Administration. During World War II, he was again called upon to advise the Government, cooperating with Federal agencies in the fuel conservation movement.

He was also a member of the Building Officials Conference of America, the Architectural League of New York, the *National Fire Protection Association*, the *American Trade Association Executives*, the Pacific Coast Building Officials Conference, and the *American Standards Association*.

Mr. Clay is survived by his wife, Mrs. Annette M. Clay, a son, Wharton Clay Jr., and three daughters, Mrs. David Humphrey, Mrs. James Van Weelden, and Mrs. William Barber. The Officers and Council extend sympathy.

•

### ARTHUR S. MORGAN
**Toronto, Canada**

Arthur S. Morgan, vice president and general sales manager of the Fess Burner Division of John Wood Co., Ltd., Toronto, Canada, died December 18 in Toronto. He was 56.

Born in Toronto on May 29, 1895, Mr. Morgan was educated in schools in that area and served overseas in World War I. Returning to Canada, he became manager of the oil burning business established by his father, the late Philip Morgan. With the merging of the company with Fess Oil Burners of Canada, Ltd., Mr. Morgan continued in charge of sales and manufacturing. During the second World War, he was assistant to the oil controller under the Department of Munitions and Supply.

Mr. Morgan was one of the founders and for many years president of the Canadian Oil Heating Association. He was an active member of the Rotary Club and was a keen hockey fan. He joined the Society in 1938 and was a member and a past president of the Ontario Chapter.

Mr. Morgan is survived by his wife, Gladys Ellis Morgan; a sister, Mrs. L. Robertson, Toronto; and five brothers, Jack, Earle, Hilliard and Douglas, all of Toronto, and George of Smiths Falls, to whom the Officers and Council extend their sympathy.

•

### LOUIS H. POGALIES
**Cleveland, Ohio**

Louis H. Pogalies, partner in the firm, Wilbur Watson Associates, Cleveland, died of a heart attack on December 24 in Cleveland.

Born on October 10, 1892, in Cleveland, Mr. Pogalies was educated in schools in the Cleveland area and was connected with Wilbur Watson Associates for virtually his entire career. He became a partner in the firm in 1945.

A specialist in heating and ventilating design, Mr. Pogalies figured importantly in many prominent projects, among them being the Cleveland Stadium, the Ravenna Ordnance Depot, the Industrial Rayon Plant in Painesville, and the Crile Veterans Hospital.

A member of the Cleveland Board of Building Standards, Mr. Pogalies joined the Society in 1931 and was connected with the Northern Ohio Chapter. He held a membership in the Fairview Park Exchange Club and was active in the West Side Turnverein.

Mr. Pogalies is survived by his wife, Margaret; a son, Walter; and a daughter, Mrs. Jean Snow. The Officers and Council extend their sincere sympathy.

•

### HENRY L. ROBERTS
**Philadelphia, Pa.**

Henry L. Roberts, a Life Member of the Society, died on December 22 in Philadelphia. Mr. Roberts, who was 77, had operated his own engineering and contracting business in Philadelphia for more than 40 years.

Born on December 13, 1874, in Norristown, Pa., and educated in schools in that area, he served for 18 years with the firm, Francis Bros. & Jellett, Philadelphia, before starting his own business in 1907.

Mr. Roberts joined the Society in 1916 and was elected to Life Membership in 1947. He was connected with the Philadelphia Chapter and was among its most active members for many years. He also was a member of the *Pennsylvania Society of Professional Engineers* and for 20 years was secretary of the Pilgrim Lodge, F & A.M.

Mr. Roberts is survived by his wife, Henrietta, and a sister, Mrs. Penrose Snyder, to whom the officers and Council extend their sympathy.

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
Headquarters: 62 Worth St., New York 13, N. Y. (Tel. WHitehall 3-0377)

JOURNAL SECTION

OFFICERS

*President* ..... Ernest Szekely
*First Vice President* ..... Reg F. Taylor
*Second Vice President* ..... L. N. Hunter
*Treasurer* ..... J. Donald Kroeker
*Executive Secretary* ..... A. V. Hutchinson
*Technical Secretary* ..... Carl H. Flink

COUNCIL

Ernest Szekely, *Chairman;* Reg F. Taylor, *Vice Chairman.*
*Three Years:* M. K. Fahnestock, P. B. Gordon, R. T. Kern, D. M. Mills.
*Two Years:* J. H. Fox, N. H. Peterson, B. H. Spurlock, Jr.
*One Year:* J. E. Haines, J. W. James, E. R. Queer, G. B. Supple, Lauren E. Seeley.

ADVISORY BOARD

Lauren E. Seeley, *Chairman:* Homer Addams, Lester T. Avery, M. F. Blankin, S. E. Dibble, S. H. Downs, E. O. Eastwood, W. L. Fleisher, H. P. Gant, F. E. Giesecke, E. Holt Gurney, L. A. Harding, H. M. Hart, C. V. Haynes, D. D. Kimball, G. L. Larson, S. R. Lewis, A. J. Offner, F. B. Rowley, A. E. Stacey, Jr., G. L. Tuve, A. C. Willard, C. E. A. Winslow and B. M. Woods.

## Radiant Heat in Historic Church

**By Ralph C. Taggart*, Lancaster, Mass.**

First Parish Church
Lancaster, Mass.

THE FIRST Parish Church of Lancaster, Mass., built in 1816, contains the same radiant heating system installed over 70 years ago, which is still in use today. It might be of some interest to elaborate here on the details of this historic church and its heating system.

The Church itself is well known both architecturally and historically, and was designed by Charles Bulfinch, the architect of the State House, Boston, Mass. The Church bell was made by Paul Revere. Incidentally, the bell was rung for five minutes at noon on Patriot's Day, April 19, 1951, along with many other Paul Revere bells in New England churches, some 100 or more in number.

The Church auditorium is 70 ft in length by 63 ft in width, with galleries on each side and at the rear. The ceiling height measures nearly 30 ft, and ten 4 by 8 ft windows line each side of the auditorium, five above and five below the gallery. During the colder weather, storm sashes are installed on the first floor windows, and occasionally on the windows above the galleries. The pulpit gallery is at the front of the Church on a somewhat lower level than the side galleries.

Two wood-burning stoves, 35 in. by 15 in. wide, are installed on each side of the rear of the Church. The smoke pipe, 8 in. in diameter, from each stove rises and is carried for the full length of the Church, in front, and at the lower level, of the gallery, with a small upward pitch. At the front of the Church, each smoke pipe rises to the ceiling and is connected to a chimney above the auditorium ceiling.

The Church is heated by the radiant heat from the smoke pipes. Fires warm the Church before the congregation assembles, and while some parts of the Church, of course, are not as well heated as others, generally speaking, a sufficient portion of the Church is satisfactorily heated for the congregation. However, it is suspected that the earliest congregations may have carried foot warmers in cold weather.

While the exact date of the original installation is unknown, the recollection of Dr. Bartol, now 77, whose father was pastor of the Church from 1847-1906, is that the present heating has served for over 70 years.

*Life Member of ASHVE.

### EDWARD SIMONS *ASRE* PRESIDENT

Edward Simons, consulting engineer of San Francisco, Calif., and a member of ASHVE, was installed as president of the *American Society of Refrigerating Engineers* at the final session of the group's 47th Annual Meeting held in the Hotel Roosevelt, New Orleans, La., December 5. Four other ASHVE members were also elected to important *ASRE* posts, two as vice presidents and two as directors. Elected to vice president positions are: Dr. R. C. Jordan, Minneapolis, Minn., and A. J. Hess, Los Angeles, Calif. Named as directors are D. D. Wile, Los Angeles, Calif., and H. H. Peterson, Yakima, Wash.

**Plan Now**
**for the**
**Seashore Meeting**
**at**
**SPRING LAKE, N. J.**

**SEMI-ANNUAL**
**MEETING 1952**
**June 16-18 at**
**THE ESSEX & SUSSEX**

# JOURNAL SECTION

## OFFICERS OF LOCAL CHAPTERS AND STUDENT BRANCHES

(66 Chapters—11 Student Branches)

● **ATLANTA:** Organized 1937. Headquarters, Atlanta, Ga. Meets, Second Monday. PRESIDENT, F. A. Platz, 2110 Peachtree Rd., N. W., Atlanta. SECRETARY, J. M. Lazenby, 2641 Merry Lane, N. E., Atlanta 6.

● **BALTIMORE:** Organized 1949. Headquarters, Baltimore, Md. Meets, Third Wednesday. PRESIDENT, W. P. Flanigan, 5508 Greenleaf Rd., Baltimore 10. SECRETARY, F. M. Hewitt, 11 E. 21st St., Baltimore 18.

● **CENTRAL NEW YORK:** Organized 1944. Headquarters, Syracuse, N. Y. PRESIDENT, J. H. Carpenter, 3515 Midland Ave., Syracuse. SECRETARY, H. K. Ormsby, 205 S. Townsend St., Syracuse 2.

● **CENTRAL OHIO:** Organized 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. PRESIDENT, R. S. Curl, 590 Oak St., Columbus. SECRETARY, N. T. Hess, 63 E. Goodale St., Columbus.

● **CINCINNATI:** Organized 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. PRESIDENT, J. J. Bechtol, P.O. Box 1667, Cincinnati 1. SECRETARY, R. C. Beineke, 626 Broadway, Cincinnati 2.

● **CONNECTICUT:** Organized 1940. Headquarters, New Haven, Conn. Meets, Third Thursday. PRESIDENT, A. J. Lawless, 110 Whitney Ave., New Haven. SECRETARY, R. W. Sidbury, 236 Grand St., Waterbury 91.

● **DELTA:** Organized 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. PRESIDENT, Theodore Offner, 1000 S. Peters St., New Orleans. SECRETARY, H. L. Salaun, 317 Baronne St., New Orleans.

● **EMPIRE STATE CAPITAL:** Organized 1951. Headquarters, Albany, N. Y. PRESIDENT, D. A. Carofano, 1821 Highland Ave., Troy. SECRETARY, G. G. Davis, 323 State St., Schenectady.

● **GOLDEN GATE:** Organized 1937. Headquarters, San Francisco, Calif. Meets, First Thursday. PRESIDENT, T. J. Janes, University of California, Dept. of Grounds & Bldgs., Berkeley 4. SECRETARY, J. E. Murray, 1095 Market St., San Francisco 3.

● **ILLINOIS:** Organized 1906. Headquarters, Chicago, Ill. Meets, Second Monday. PRESIDENT, George W. Bornquist, 605 W. Washington Blvd., Chicago 6. SECRETARY, G. V. Zintel, 1217 W. Washington Blvd., Chicago 7.

● **INDIANA:** Organized 1943. Headquarters, Indianapolis Ind. Meets, Fourth Friday. PRESIDENT, F. C. Barton, 912 K. of P. Bldg., Indianapolis. SECRETARY, R. C. Blackman, 5505 N. Illinois St., Indianapolis 8.

● **INLAND EMPIRE:** Organized 1950. Headquarters, Spokane, Wash. Meets, First Friday after First Tuesday. PRESIDENT, L. E. Marque, 3803 N. Atlantic, Spokane. SECRETARY, R. J. Harris, 116 N. Division St., Spokane 8.

● **IOWA:** Organized 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. PRESIDENT, C. H. McGuiness, 712 Park St., Des Moines. SECRETARY, J. F. Sandfort, M. E. Dept., Iowa State College, Ames.

● **KANSAS:** Organized 1951. Headquarters, Wichita, Kan. PRESIDENT, R. F. Bauer, 434 N. Rock Island, Wichita. SECRETARY, E. G. Fahnestock, P.O. Box 2581, Hillside Station, Wichita.

● **KANSAS CITY:** Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. PRESIDENT, C. W. Schumacher, 1920-22 Grand Ave., Kansas City, Mo. SECRETARY, G. H. Stoffer, 200 Riss Bldg., 15 West 10th St., Kansas City 6, Mo.

● **MANITOBA:** Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. PRESIDENT, J. F. Bertram, 550 Notre Dame Ave., Winnipeg. SECRETARY, A. K. Piercy, 222 Osborne St., N., Winnipeg.

● **MASSACHUSETTS:** Organized 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. PRESIDENT, John Bonner, 92 Broadway, Cambridge 42. SECRETARY, L. R. Geissenhainer, 89 Broad St., Boston 10.

● **MEMPHIS:** Organized 1944. Headquarters, Memphis, Tenn. Meets, Third Monday. PRESIDENT, R. E. Larkin, 515 W. Clover Dr., Memphis. SECRETARY, A. T. Bevil, 212 Robinson Bldg., 160 Union, Memphis 3.

● **MIAMI VALLEY:** Organized 1950. Headquarters, Dayton, Ohio. Meets, First Wednesday. PRESIDENT, C. D. Weaver, 1136 U.B. Bldg., Dayton 2. SECRETARY, R. W. Kimmel, 947 Westminster Pl., Dayton 9.

● **MICHIGAN:** Organized 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. PRESIDENT, G. W. Akers, Box 238, R.F.D. 2, Rochester, Mich. SECRETARY, R. H. Oberschulte, 316 McKerchey Bldg., Detroit 1.

● **MINNESOTA:** Organized 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. PRESIDENT, E. F. Snyder, Jr., 4324 Zenith Ave. N, Minneapolis 22. SECRETARY, J. A. Holbrook, 65 North 17th St., Minneapolis 3.

● **MONTREAL:** Organized 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. PRESIDENT, J. G. Chenevert, 1440 St. Catherine St. W., Montreal. SECRETARY, B. J. Horsburgh, 637 Craig W., Rm. 212, Montreal.

● **NEBRASKA:** Organized 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. PRESIDENT, K. E. Martin, 204 Barker Bldg., Omaha 2. SECRETARY, O. J. Smith, 233 Grain Exchange Bldg., Omaha 2.

● **NEW YORK:** Organized 1911. Headquarters, New York, N. Y. Meets, Third Monday. PRESIDENT, Ernst Gerber, 215 Hollywood Ave., Douglaston, L. I. SECRETARY, Carl H. Flink, 62 Worth St., New York 13.

● **NORTH CAROLINA:** Organized 1939. Headquarters, Durham, N. C. Meets, Quarterly. PRESIDENT, L. L. Vaughan, P. O. Box 5746, Raleigh. SECRETARY, C. A. McKeeman, M.E. Dept., North Carolina State College, Raleigh.

● **NORTH TEXAS:** Organized 1938. Headquarters, Dallas, Tex. Meets, Third Monday. PRESIDENT, R. E. Allison, 607-11 First Ave., Dallas 10. SECRETARY, M. W. Brown, 1215 Texas Bank Bldg., Dallas 2.

● **NORTHEASTERN OKLAHOMA:** Organized 1948. Headquarters, Tulsa, Okla. PRESIDENT, C. H. Dollmeyer, Jr., 1533 N. New Haven Ave., Tulsa 15. SECRETARY, V. W. Miles, 624 So. Boston Ave., P. O. Box 871, Tulsa.

● **NORTHERN OHIO:** Organized 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. PRESIDENT, John Richmond, 10210 Woodland Ave., Cleveland 4. SECRETARY, R. G. Huebscher, 7218 Euclid Ave., Cleveland 3.

● **OKLAHOMA:** Organized 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. PRESIDENT, J. H. Carnahan, 320 Oklahoma Natural Gas Bldg., Oklahoma City 2. SECRETARY, W. J. Collins, Jr., 224 Oklahoma Natural Gas Bldg., Oklahoma City.

● **ONTARIO:** Organized 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. PRESIDENT, William Phelps, 5 Barbara-Crescent, Toronto, Ont. SECRETARY, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

● **OREGON:** Organized 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. PRESIDENT, H. W. McKenzie, 399 Murray Ave., Beaverton. SECRETARY, R. P. Lankow, 3408 S.E. Hawthorne Blvd., Portland 15.

● **PACIFIC NORTHWEST:** Organized 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. PRESIDENT, R. M. Stern, 5121 E. 68th, Seattle 5. SECRETARY, H. T. Orebaugh, 1330 Dearborn, Seattle.

● **PHILADELPHIA:** Organized 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. PRESIDENT, E. K. Wagner, 2240 N. Broad St., Philadelphia 32. SECRETARY, A. M. Robertson, 1200 Locust St., Philadelphia 7.

● **PITTSBURGH:** Organized 1919. Headquarters, Pittsburgh, Pa. Meets, Third Monday. PRESIDENT, W. D. Simpson, 301 Standard Life Bldg., Pittsburgh 22. SECRETARY, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

● **ROCKY MOUNTAIN:** Organized 1944. Headquarters, Denver, Colo. Meets, First Wednesday. PRESIDENT, B. H. Spurlock, Jr., Dept. of M. E., University of Colorado, Boulder, Colo. SECRETARY, J. W. Braak, 1230 California St., Denver, Colo.

● **ST. LOUIS:** Organized 1918. Headquarters, St. Louis, Mo. Meets, Second Tuesday. PRESIDENT, L. L. Hamig, 1706 Olive St., St. Louis 3. SECRETARY, J. F. Naylor, Jr., 2335 S. Grand Ave., St. Louis 4.

● **SHREVEPORT:** Organized 1948. Headquarters, Shreveport, La. Meets, Third Thursday. PRESIDENT, R. M. Hood, 411 Louisiana Ave., Shreveport, La. SECRETARY, M. A. Hudson, 4609 Gilbert Dr., Shreveport.

● **SOUTH TEXAS:** Organized 1938. Headquarters, Houston, Tex. Meets, Third Friday. PRESIDENT, R. J. Salinger, 910 Bankers Mtg. Bldg., Houston 2. SECRETARY, E. G. Floeter, Jr., P.O. Box 6006, Houston 6.

● **SOUTHERN CALIFORNIA:** Organized 1930. Headquarters, Los Angeles, Calif. Meets, First Tuesday. PRESIDENT, M. C. Greiner, 1559 Club View Dr., Los Angeles 24. SECRETARY, L. B. Davenport, 137 S. Anderson St., Los Angeles 33.

● **SOUTHWEST TEXAS:** Organized 1946. Headquarters, San Antonio, Tex. Meets, Third Tuesday. PRESIDENT, W. E. Long, Dept. of Mechanical Engrg., University of Texas, Austin. SECRETARY, L. H. Hornot, Jr., 810 Insurance Bldg., San Antonio.

● **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. PRESIDENT, A. R. Curtis, 5158 Cottonwood Lane, Holladay. SECRETARY, M. L. Gollaher, 1165 Roosevelt Ave., Salt Lake City 5.

● **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. Meets Third Wednesday. PRESIDENT, J. F. Boyenton, 400 W. 24 St., Norfolk 8. SECRETARY, J. E. Harding, Apt. R-2, St. James Terrace, Newport News.

● **WASHINGTON, D. C.:** Organized 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. PRESIDENT, S. R. Allen, 942 Washington Bldg., Washington 5. SECRETARY, P. H. Loughran, Jr., 4513 49th St., N.W., Washington 16.

● **WESTERN MICHIGAN:** Organized 1931. Headquarters, Grand Rapids, Mich. Meets Second Monday. PRESIDENT, W. C. DeRoo, 500 E. 8th St., Holland, Mich. SECRETARY, P. D. Winchester, 322 Columbia Ave., Holland, Mich.

● **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, T. F. Killeen, 374 Delaware Ave., Buffalo 2. SECRETARY, R. E. Lang, 140 Meadow Lane, Kenmore 23.

● **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, H. F. Brinen, 226 Kenzie Ave., Racine. SECRETARY, L. C. Plaehn, 914 N. Broadway, Milwaukee.

### Student Branches

● **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Seymour Weinberg, 2147 72nd Street, Brooklyn 4. SECRETARY, Benjamin Karp, 524 Berriman St., Brooklyn 8.

● **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, W. G. McMullen, Box 472, Tech Station, Ruston. SECRETARY, R. L. Gorton, Box 184, Tech Station, Ruston.

● **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, Sydney Narvey, 5-B Vetville, State College Station, Raleigh. SECRETARY, E. A. Travis, Jr., P.O. Box 3333, Bagwell Dormitory, Raleigh.

● **OKLAHOMA A. & M. COLLEGE:** Organized 1950. Headquarters, Stillwater, Okla. PRESIDENT, O. A. Brynie, 507 Midi, Vet Village, Stillwater. SECRETARY, D. W. Ray, W36, Bennett Hall, Stillwater.

● **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, R. J. Kemper, Jr., 645 N. 4th, Corvallis. SECRETARY, J. M. Templer, 720 Kings Rd., Corvallis.

● **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, N. J. Kirch, 922 Highland Ave., Lafayette. SECRETARY, H. F. Allen, Jr., 629 University St., W. Lafayette.

● **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, J. O. Kadel, Box 4054, College Station, Tex. SECRETARY, W. C. Haggard, Box 5227, College Station.

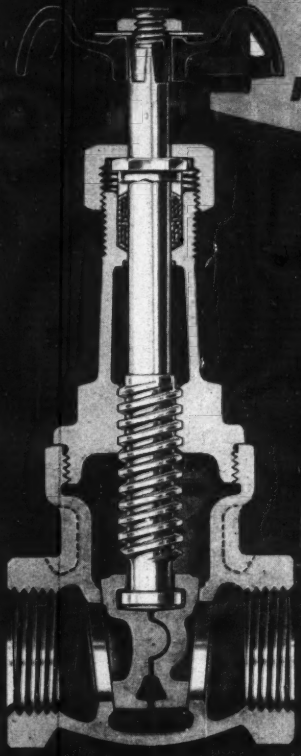
● **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets, First Tuesday. PRESIDENT, G. H. Williams, 1824 Washburn, Detroit 21. SECRETARY, R. H. Drake, 5598 Hurlbut, Detroit 13.

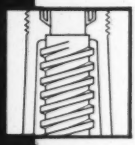
● **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. Address mail to Dr. Warren E. Snyder, chairman, Dept. of Mechanical Engineering, University of Kansas.

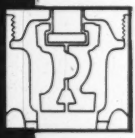
● **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets. First and Third Tuesday. PRESIDENT, W. A. Cox, 360-D Deep Eddy Apts., Austin. SECRETARY, V. H. Miles, PHP Dorm J, Austin.

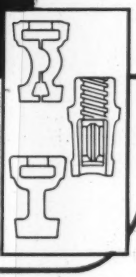
● **UNIVERSITY OF TORONTO:** Organized 1951. Headquarters, Toronto, Ont. CHAIRMAN, H. F. Spragg, 35 Harrison Ave., Aurora, Ont. SECRETARY, J. E. G. Blaiklock, 23 Isabella St., Toronto 5, Ont.

# ARE YOU GETTING THESE ADVANTAGES FROM YOUR BRONZE VALVES?









**STEMALLOY**

This amazing silicon bronze alloy, an exclusive Lunkenheimer development, eliminates stem-thread failure, has actually been tested at 300,000 openings and closings!

**REPACKING SEATS**

You can repack while the valve is wide open and under pressure. Perfectly machined backseating surfaces are located above stem threads where scale does not collect.

**STAY-ON DISCS**

Double-wedge disc sections are pressed against bonnet when valve is fully opened, won't fall out when bonnet assembly is removed.

**HEXAGON HEAD GLAND**

Six faces are provided for secure wrench grip to loosen and raise gland. No more troublesome prying, as with old-fashioned round type.

**INTERCHANGEABILITY**

Choose a rising or non-rising stem; double-wedge, solid wedge, or single-wedge disc. Switch trim for any service, and provide new parts as you need them. With these valves in stock, you keep inventories low —yet never have shortages.

**WRITE FOR**

*"Lunkenheimer Copper Base Alloys,"* a useful book which explains valve metals, helps you choose the *right* valves for specific jobs. Ask your distributor, or write The Lunkenheimer Co., Box 360N Cincinnati 14, Ohio.

BRONZE • STEEL • IRON

# LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-751-1

# TACO *has a proved record of helping*

**FACTORIES • OFFICE BUILDINGS • SCHOOLS • HOSPITALS • CHURCHES • STORES**

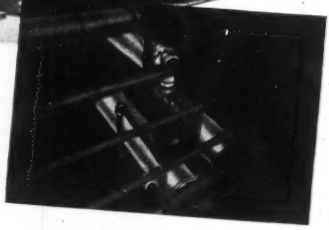
## SOLVE THEIR HEAT and HOT WATER PROBLEMS . . .

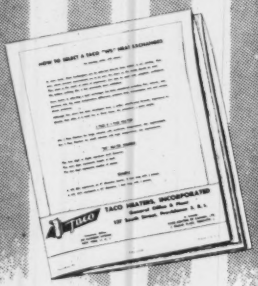
***Provides hot water for wash fountains and showers for employees***

Taco water heaters are supplying abundant low cost hot water in industrial plants throughout the United States. Our more than 30 years' experience in this field is a big help to those with hot water heating problems.

***Heats entire building with heat formerly thrown away***

A large industrial user of steam was dumping the condensate from their steam processing into a creek. Now, thanks to the 3 Taco heat exchangers on the right, they're reclaiming enough to heat the 220' x 560 building shown above. Taco products can perhaps do a similar service for you.





***ENGINEERS . . . WRITE FOR***

simplified selection chart for sizing Taco water heaters under any conditions such as steam pressure, temperature rise and pressure drop.

***Better Heating-Better with Taco***

**A TRAINED TACO SALES ENGINEER IS AVAILABLE WHENEVER YOU NEED HIS HELP**

**TACO HEATERS, INCORPORATED** 137 SOUTH STREET • PROVIDENCE 3, R. I.

# There's No Other Welding Tee Like This!

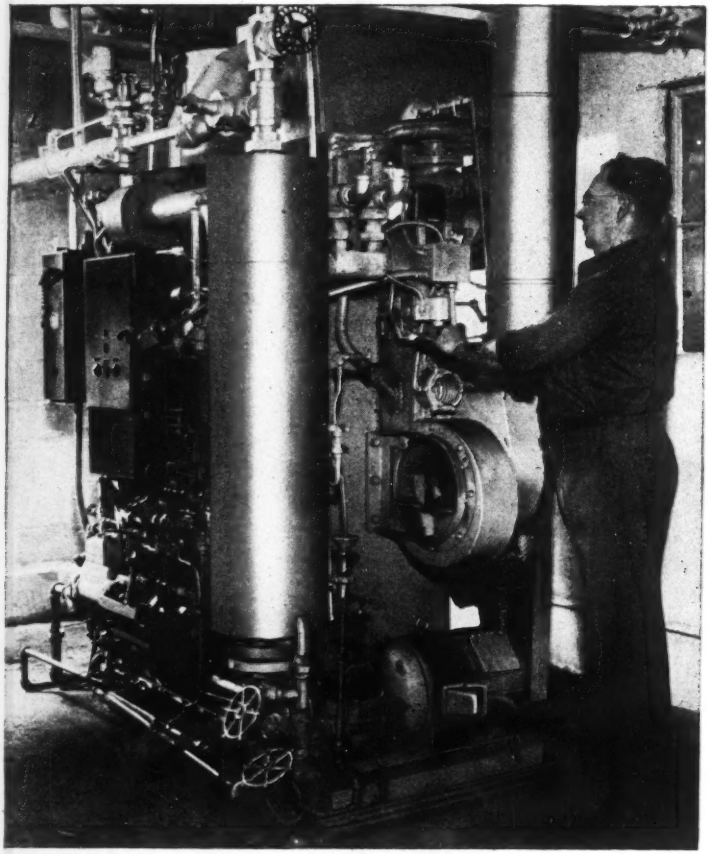
# FLOWLINE
TRADE MARK

STAINLESS STEEL, MONEL, NICKEL and INCONEL WELDING FITTINGS
Preferred for Dependable Corrosion Service

## Features of FLOWLINE Tees

- Cold formed – seamless – by the exclusive Welding Fittings process.
- Reinforced crotch – tee is stronger than pipe with which it is used.
- Full center to face dimensions.
- Smooth interior walls.
- Ends machine tool cut and finished.
- Annealed, cleaned bright, passivated.
- Heat number permanently stamped on each tee as record of actual analysis and physical properties.
- Every tee is marked with type of metal, size, schedule, wall thickness, and FLOWLINE trade mark.

**WELDING FITTINGS CORP.**
NEW CASTLE, PENNSYLVANIA
*World's Largest Manufacturer of Stainless Welding Fittings*



*Why not—*

# make your steam *where you use it?*

You buy a boiler 15 or 20 feet square (or more) and just as high, and chances are you don't have room to install it very near to the places — often widely separated — where steam is to be used. So what do you do? You install, insulate and maintain expensive steam lines from the place the steam is produced to its point of use and then you continue to pay for inevitable condensation losses which can only mean higher steam costs.

Why?

Well, for one reason — some situations may make that the only practical way to do the job. *But* — in a great many instances you'll make a big saving in time, space and money by selecting the C-E Re-circulation Steam Generator — the unit that permits you to make steam *where* you *use* it.

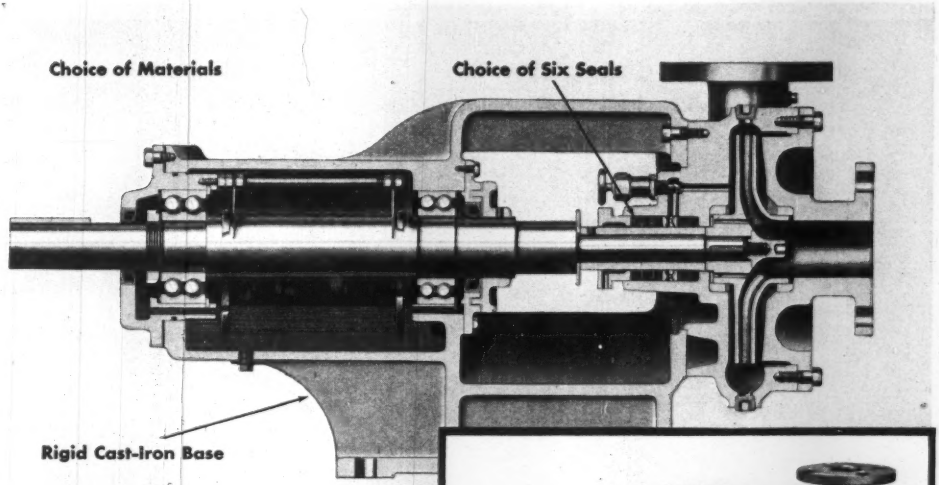
If you have a space 7 feet square and about that high, that's all you need to set up the C-E Re-circulation Steam Generator. It's more than a "package" boiler — it's a complete steam plant including all controls and auxiliaries — a fully integrated unit — producing up to 6,000 pounds of steam per hour.

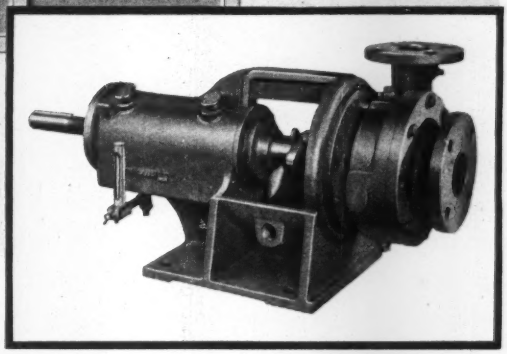
• • •

So — if you need steam . . . for heating or processing — or both . . . for a location in your plant not now served by your existing boiler plant . . . for an occasional demand which exceeds the capacity of present boilers — if you want any or all of these, plus the advantages of maximum output from minimum space, then your best bet is the C-E Re-circulation Steam Generator. Don't buy any boiler in its capacity range until you investigate C-E.

**COMBUSTION ENGINEERING — SUPERHEATER, INC.**

**200 Madison Avenue, New York 16, N. Y.**



Pedestal-Mounted Chemical Pumps

# Tailored to Your Job

## FOR LOW COST PER GALLON PUMPED

HERE'S HOW it's engineered for your job! You start with the standard pedestal-mounted pump with: rigid cast iron pedestal; two heavy duty oil lubricated bearings; big oil reservoir. Then, working with A-C engineers, the optional constructions are selected. These will vary with liquid being pumped . . . its temperature, acidity, alkalinity, etc.

Shaft, sleeve, impeller, and wearing rings are all available in many types of material. In addition, six alternate sealing arrangements, including a water-cooled stuffing box, are available.

A-C engineers have had long experience covering many chemical pumping jobs. They can help you get a pump for your specific job that will give you low cost per gallon pumped.

### Complete Pumping Units

Remember too, Allis-Chalmers can supply complete pumping units — pump, motor, drive, and control — all mounted on a rigid base ready to install and run. You save time and installation cost. Guarantee covers the complete installation.

Capacities to 1200 gpm; heads to 250 feet; temperatures to 500 degrees F. Call your nearby A-C district office for bulletin 52B7638, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3587

# ALLIS-CHALMERS

"I CAN'T DO A THING WITH THEM SINCE HE STARTED EXPLAINING ABOUT THE QUALITY AND WORKMANSHIP OF READING COPPER TUBING!"

**Today, of course, much of our production of long-wearing Reading Copper Tubing is earmarked for essential defense orders. But, you can count on our continued cooperation to keep you supplied with as much tubing for civilian use as government restrictions permit.**

READING COPPER TUBING

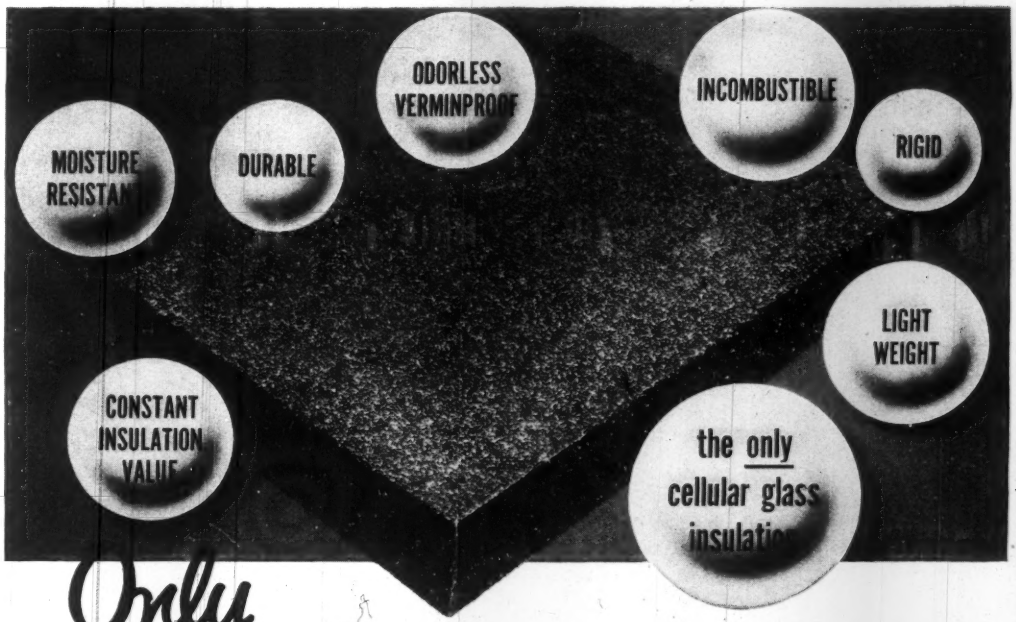
**READING TUBE CORPORATION**

*Producers of Reading Lektroneal Copper Tubing and Reading 85% Grade A Red Brass Pipe*

*OFFICES AND EASTERN DISTRIBUTION DEPOT:*
**36-12 47th AVE., LONG ISLAND CITY, N. Y.**
WORKS: READING, PA. STillwell 6-9200

***Stocks Available at ALL Reading Distribution Depots:***

• READING, PA. • HOUSTON, TEXAS: 1121 Rothwell St.
• LONG ISLAND CITY, N. Y. • CHICAGO, ILL.: 724 W. 50th St.




# Only FOAMGLAS®

## gives you all these advantages

**FOAMGLAS** is the only insulating material composed of millions of tiny glass bubbles containing still air. Still air is the world's best practical insulation. Glass, in this cellular form, has exceptionally high resistance to many elements that cause other materials to deteriorate.

That is why FOAMGLAS, the only cellular glass insulating material, is such an effective, long lasting, economical insulation.

The eight features mentioned above are the main reasons for the rapidly increasing use of FOAMGLAS for hot and cold piping in walls and ceilings, on roofs and under floors in all sorts of structures.

When next you figure on insulation, be sure to get all the advantages you enjoy only with FOAMGLAS. Send the coupon for sample and informative booklets.

PITTSBURGH PC CORNING ®

Pittsburgh Corning Corporation
Dept. AF-22, 307 Fourth Avenue
Pittsburgh 22, Pa.

Please send me without obligation a sample of FOAMGLAS and your FREE booklets on the use of FOAMGLAS Insulation for Normal Temperature Commercial, Industrial and Public Buildings ☐, Refrigerated Structures ☐, Piping and Process Equipment ☐.

Name .....

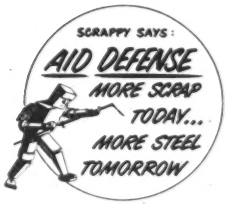
Address .....

City ..... State .....

**PITTSBURGH CORNING CORPORATION · PITTSBURGH 22, PA.**

## Going round and round with CMP?

**Let us try to help you!** Call one of our salesmen when you have a problem on CMP. He has handled a large volume of orders certified under CMP regulations and is familiar with the application of these rules to most steel supply problems. He will do everything possible to help you.

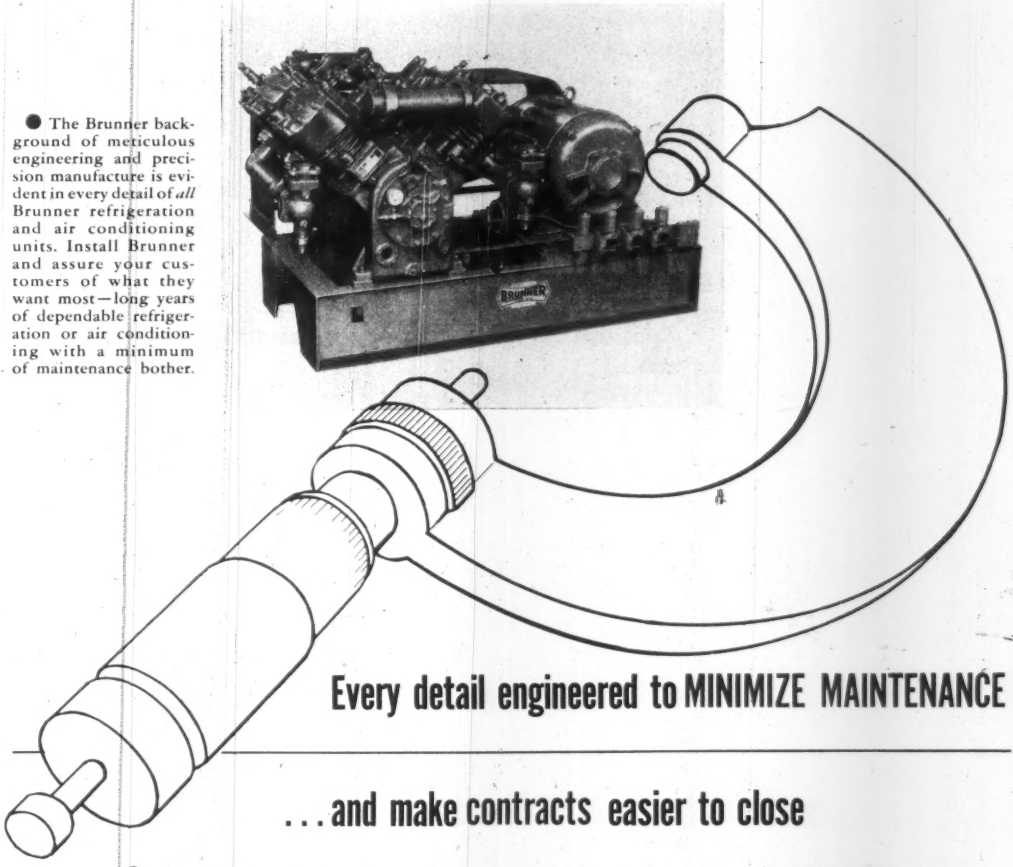



**UNITED STATES STEEL SUPPLY DIVISION**
**UNITED STATES STEEL COMPANY**

HEADQUARTERS: 208 So. LA SALLE ST., CHICAGO 4, ILL. WAREHOUSES COAST-TO-COAST
Warehouses and Sales Offices: BALTIMORE · BOSTON · CHICAGO · CLEVELAND · LOS ANGELES · MILWAUKEE · MOLINE, ILL. NEWARK · PITTSBURGH · PORTLAND, ORE. · SAN FRANCISCO · SEATTLE · ST. LOUIS · TWIN CITY (ST. PAUL)
Sales Offices: INDIANAPOLIS · KANSAS CITY, MO. · PHILADELPHIA · PHOENIX · ROCKFORD, ILL. · SALT LAKE CITY · TULSA · TOLEDO · YOUNGSTOWN

**UNITED STATES STEEL**

● The Brunner background of meticulous engineering and precision manufacture is evident in every detail of *all* Brunner refrigeration and air conditioning units. Install Brunner and assure your customers of what they want most—long years of dependable refrigeration or air conditioning with a minimum of maintenance bother.



## Every detail engineered to MINIMIZE MAINTENANCE

## . . . and make contracts easier to close

● If you are in business to sell and install air conditioning and refrigeration, there is food for thought in the rapidly increasing number of Brunner Contractors.

We have the capacity range in equipment and the manufacturing facilities to deliver. Our application engineering staff is ready with the kind of help that wins contracts.

New ideas and improvements are constantly under test in our engineering laboratories to keep Brunner customers in the vanguard on refrigeration and air conditioning developments.

● Our course is shaped for contractor profits. There are many advantages to be enjoyed in selling Brunner equipment. Why not get the entire Brunner story . . . now?

BRUNNER
SINCE 1906

**AIR CONDITIONING AND REFRIGERATION**

**BRUNNER MANUFACTURING CO., UTICA 1, NEW YORK, U. S. A.**

BRUNNER
SINCE 1906

**AIR CONDITIONING**
Self Contained Units to 10 hp.
For remote installations Brunner Condensing Units to 75 hp.

**REFRIGERATION**
Condensing Units from ¼ hp. to 75 hp. 69 Air and Water Cooled Models.

**AIR COMPRESSORS**
Single stage ¼ hp. to 2 hp. Two stage 1½ hp. to 15 hp. Horizontal and Vertical Models.

# Santa Rosa Hospital Built for Reliability . . . and Selected

# KEWANEE

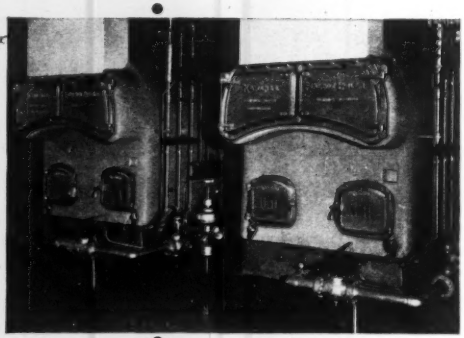
## HEAVY-DUTY BOILERS

**SANTA ROSA HOSPITAL,** San Antonio, Tex.

PHELPS, DEWEES & SIMMONS, Architects

GUARD M. BAKER, Engineer

JUD PLUMBING & HEATING CO., Heating Contractors



By specifying Kewanee Heavy-Duty Boilers, for 100, 125 or 150 pounds working pressure, large institutions can be certain of dependable heat at all times with an ample reserve for emergencies . . . *plus high pressure steam* for kitchens, laundries, sterilization and other equipment.

Pictured is the Santa Rosa Boiler Room with its battery of 2 Heavy-Duty Kewanees each of 270 HP . . . producing a total of 15,000 lbs. steam hourly.

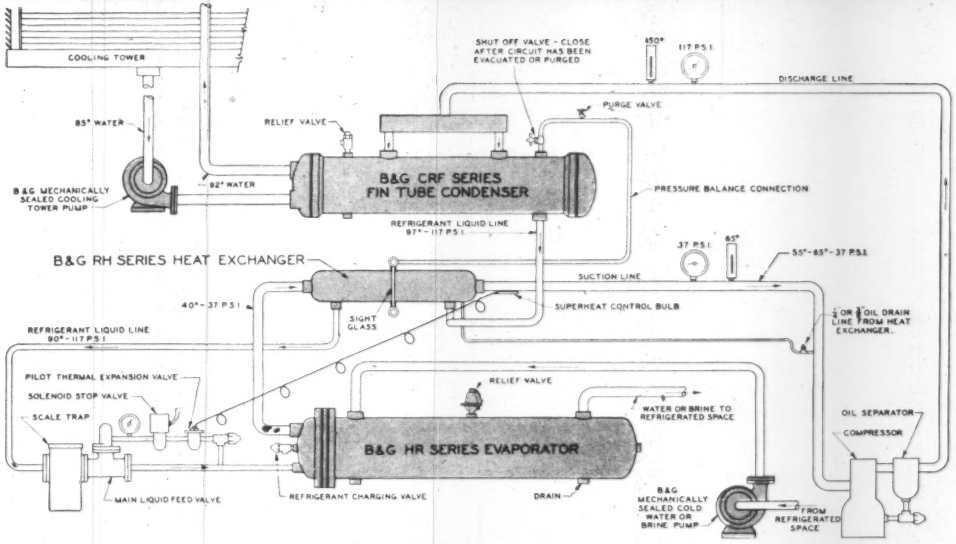
KEWANEE BOILER CORPORATION
KEWANEE, ILLINOIS
Eastern District Office: 40 West 40th St., New York City 18
Division of American Radiator & Standard Sanitary Corporation

KEWANEE BOILERS

*Serving home and industry*

AMERICAN-STANDARD · AMERICAN BLOWER · ACME CABINETS · CHURCH SEATS · DETROIT LUBRICATOR · KEWANEE BOILERS · ROSS HEATER · TONAWANDA IRON

# *Matched* UNITS FOR *Matchless* PERFORMANCE




**Typical refrigeration system, using B & G Equipment**

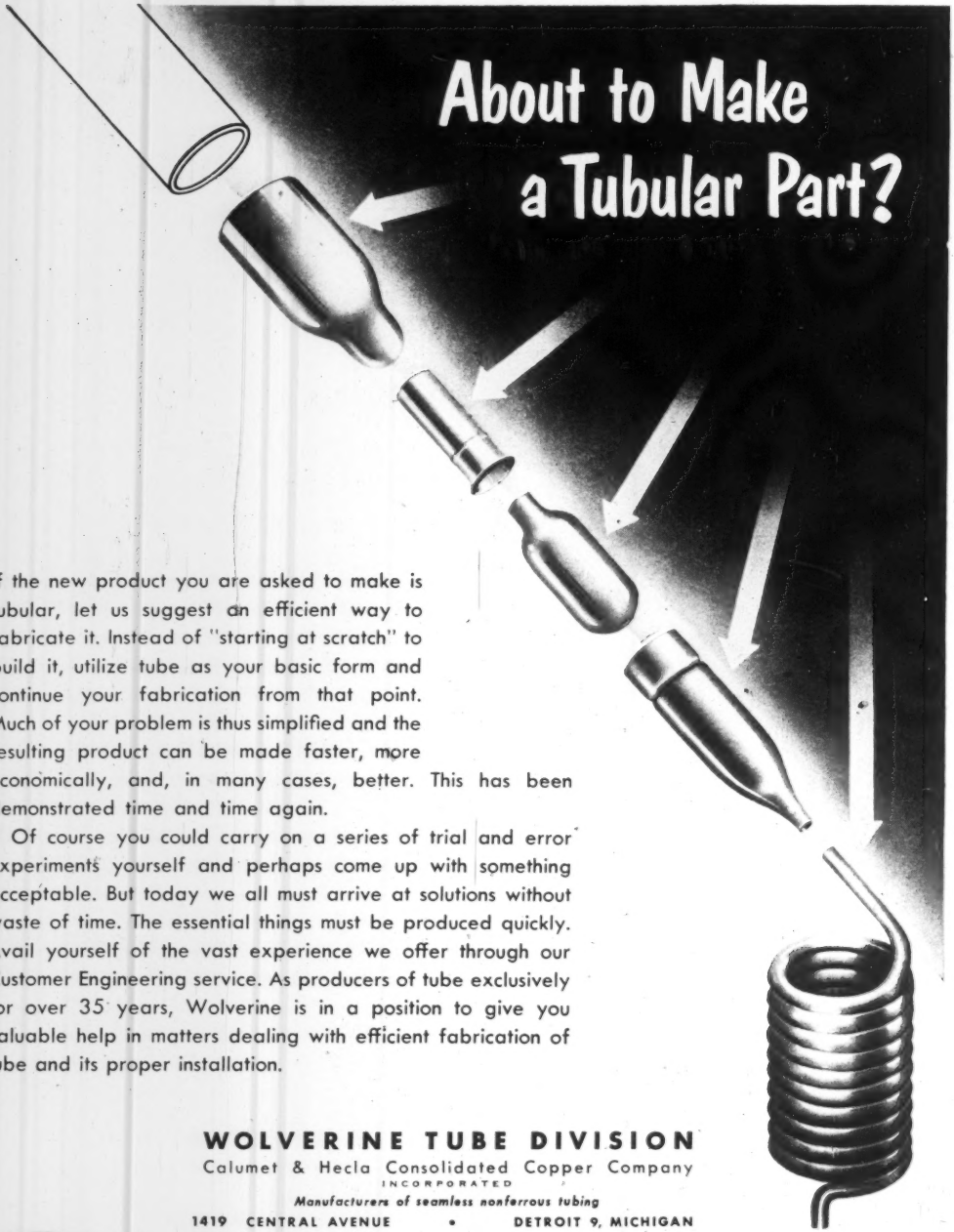
By specifying B & G Refrigeration Equipment throughout you receive the benefits of a completely integrated installation . . . plus the advantage of a guarantee from a *single* manufacturer.

B & G Condensers, Evaporators and Heat Exchangers are designed to deliver maximum tonnage with minimum operating expense. These units give long, trouble-free service—*because they are built right*—and have proved it in the field. You'll be particularly interested in the design of the B & G Evaporator, which prevents oil-trapping in the head passes—a warranty of more efficient and dependable performance.

As for pumps, you can spot superiority the moment you lay eyes on a B & G Series 1522 UNIBUILT. Among the many features of this pump are the leak-proof Mechanical Seals—hydraulically and dynamically balanced impellers—standard motors and interchangeable parts.

Send today for a complete file of B & G Catalogs.

# About to Make a Tubular Part?



If the new product you are asked to make is tubular, let us suggest an efficient way to fabricate it. Instead of "starting at scratch" to build it, utilize tube as your basic form and continue your fabrication from that point. Much of your problem is thus simplified and the resulting product can be made faster, more economically, and, in many cases, better. This has been demonstrated time and time again.

Of course you could carry on a series of trial and error experiments yourself and perhaps come up with something acceptable. But today we all must arrive at solutions without waste of time. The essential things must be produced quickly. Avail yourself of the vast experience we offer through our Customer Engineering service. As producers of tube exclusively for over 35 years, Wolverine is in a position to give you valuable help in matters dealing with efficient fabrication of tube and its proper installation.

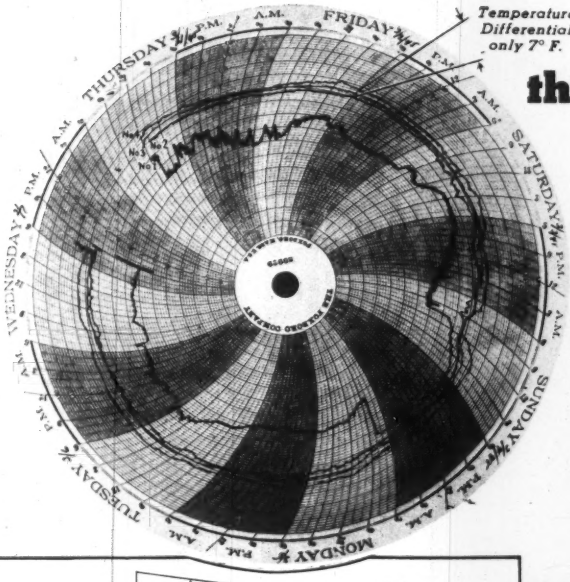
**WOLVERINE TUBE DIVISION**
Calumet & Hecla Consolidated Copper Company
INCORPORATED
*Manufacturers of seamless nonferrous tubing*
1419 CENTRAL AVENUE • DETROIT 9, MICHIGAN

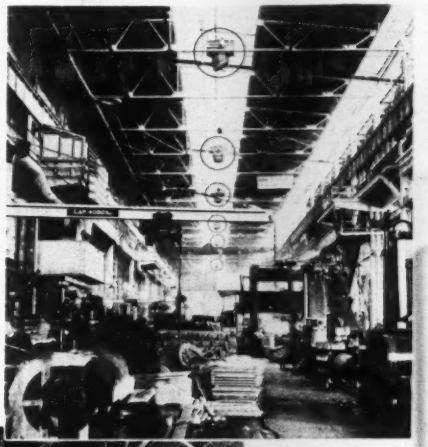
*Plants in Detroit, Mich., and Decatur, Ala.*

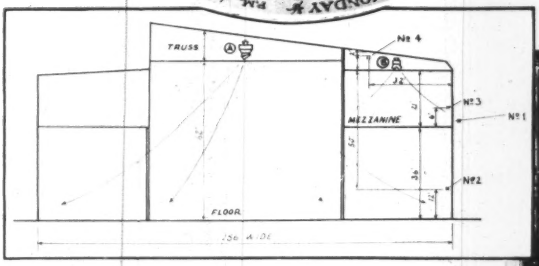
**Wolverine Mill Depots:**
DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS • LOS ANGELES, CALIF.
LONG ISLAND CITY, N. Y. • PHILADELPHIA, PA. • PROVIDENCE, R. I. • ST. LOUIS, MO.

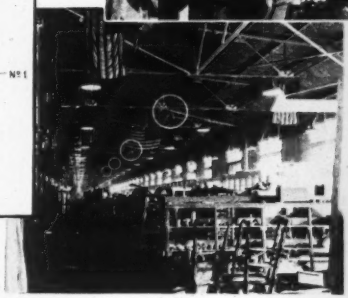
*Sales Offices in Principal Cities*

# *The* Story of the TEMPERATURE CHART





*(Above) Main section of building showing 6 of the 10 large Wing Revolving Heaters 62' above the floor.*

*(Left) View on the mezzanine, showing the smaller Wing Revolving Heaters located 21' above the mezzanine floor.*

REPLACING an expensive but inadequate heating system, Wing Revolving Unit Heaters completely solved a difficult heating problem in a shipbuilding plant. The building is 156' wide by 62' to the cross beams by 802' long. A mezzanine is 42' by 21' to the cross beams by 802' long.

Ten Wing Revolving Unit Heaters with one-way revolving discharge outlets cover the section marked "A" on the diagram and shown in the upper photograph. Ten smaller Wing Revolving Unit Heaters with Design No. 8 revolving outlets cover the mezzanine shop marked "B" on the diagram and shown in the lower photograph. Fairly high working temperatures (75° F) were required and furnished. The chart from a recording thermometer, with bulbs located as shown, reveals graphically the even working temperatures, the relatively low ceiling temperatures and the fluctuating outdoor temperatures (32° to 75° F) over one week's time.

**Wing**

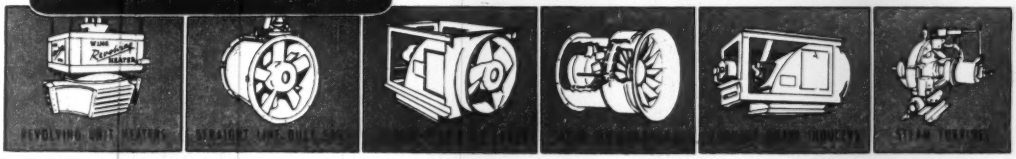
**REVOLVING UNIT HEATERS**

*Write for further details and a copy of Bulletin HR-6*

**L. J. Wing Mfg. Co., 140 Vreeland Mills Rd., Linden, N. J.**

*Factories: Linden, N. J. and Montreal, Can.*

**In Europe: Etab. WANSON, Haren-Nord, Brussels, Belgium**



# YORK *Unitary* AIR CONDITIONING

*Tenants of the world's first fully air-conditioned skyscraper apartments—Philadelphia's 25-story Rittenhouse Claridge and 20-story Rittenhouse Savoy—select their own weather with York Unitary Air Conditioning.*

**USER ADVANTAGES**

- Personal weather control
- All air filtered
- Ventilation air quantity adjustable from 0% to 100%
- Year-round conditioning
- Quiet operation
- Freedom from outside noises
- Adaptable to office partition changes
- Positive circulation and uniform distribution of air

***Saves time in planning and designing!***

***Saves cost in installation and operation!***

York Unitary Air Conditioning combines the advantages of both central system and packaged conditioner. The result is multi-room, multi-story air conditioning with lower first costs . . . lower operating costs . . . lower installation costs . . . and maximum user satisfaction.

York Unitary Air Conditioning heats in winter . . . cools and dehumidifies in summer . . . filters, ventilates and circulates all year 'round. The user tailors the weather to his taste . . . instead of being dependent on a fixed, centralized system.

Knotty planning, designing and installation problems are eliminated. Minimum space is required for installation, and in both rental area and engine room. Only three small pipes are needed—water supply and return, and drain. Since the only central system is water supply, air handling equipment is not required.

Consult your nearby York Representative today (he's listed in your Classified Directory) or write York Corporation, York, Pennsylvania.

**OWNER ADVANTAGES**

- Quick, easy and economical installation
- Economy in initial, owning and operating costs
- Only 3 pipes required —space saving
- Complete filtering of all air circulated reduces cleaning and redecorating costs
- York Unitary Air Conditioners may be installed to provide heating initially and cooling added later
- Outside air plenum simplifies ventilation air connection
- Negligible maintenance—no disturbance to tenants

York refrigeration air conditioning

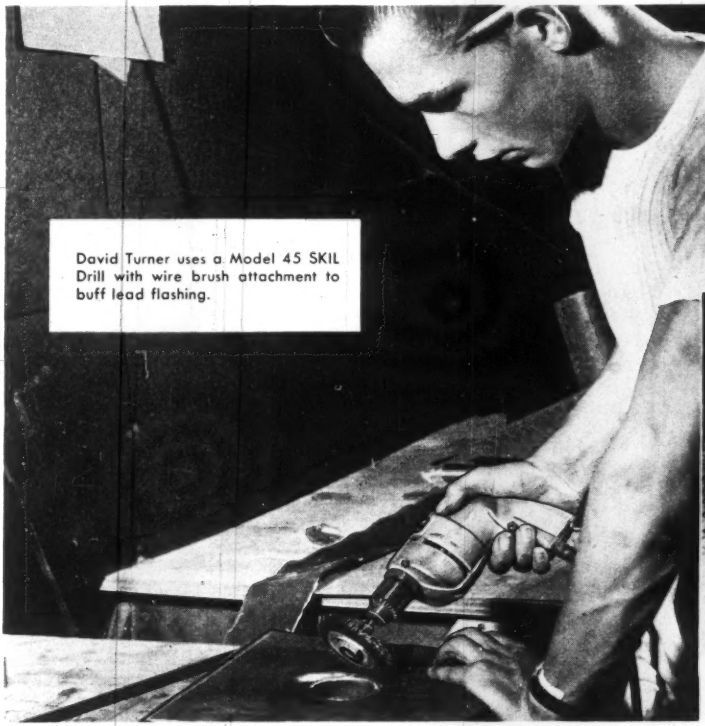
**The big advances come from YORK**

*Headquarters for*— **Refrigeration and Air Conditioning**

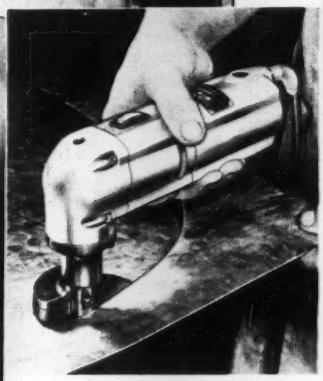
# "SKIL Drills and Shear Have Increased Our Production 350%!"

says **MR. TOM HAMPTON,**
**GATEWAY SHEET METAL SHOP,**
Houston, Texas

This company's specialty is the making of louvers for residential buildings. Tom Hampton says, "Since adding five ¼" SKIL Drills and one SKIL Shear to our tool inventory, we've increased production 350%."

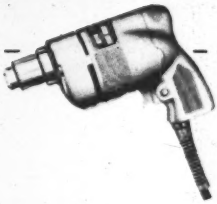


David Turner uses a Model 45 SKIL Drill with wire brush attachment to buff lead flashing.



Here the SKIL Shear is employed to cut a galvanized panel. No maintenance has been needed in 1½ years of operation.

**SKIL Shear—Model 17**—Capacity: 16 gauge hot rolled steel. Harder or softer metals in proportion. Minimum cutting radius: 1". Speed: 1500 strokes per minute, no-load. Length: 9". Weight: 5¾ lbs.



**SKIL Drill—Model 45**—Compact standard duty ¼" drill. Capacity in steel: 0" to ¼"; in hardwood: 0" to ½". 1800 r.p.m. no-load speed. Overall length: 6⅝". Weight: 3 pounds.

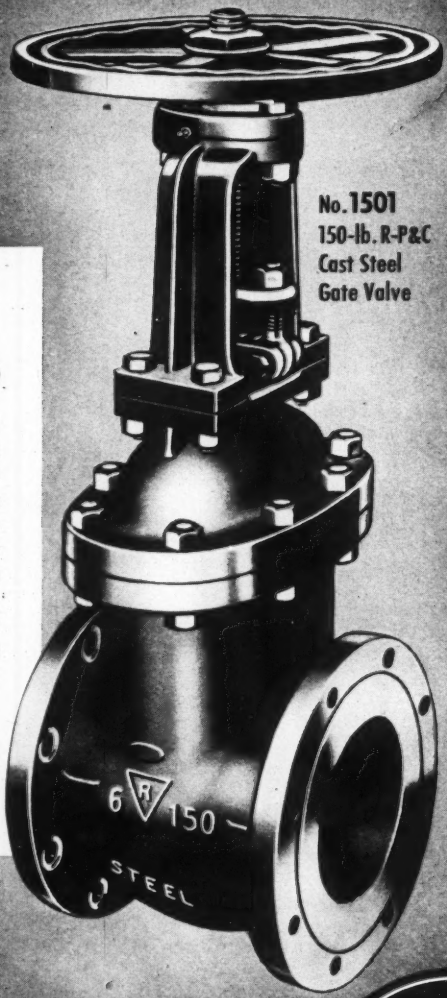
**See your Distributor for complete information or call your nearest SKILSAW factory branch.**

**SKIL Products are made only by SKILSAW, INC.**
**5033 Elston Ave., Chicago 30, Ill.**

SKILSAW Factory Branches in 34 principal cities
*In Canada:* Skiltools, Ltd.
3601 Dundas Street West, Toronto 9, Ontario

SKIL PORTABLE TOOLS

an ACCO product




No. 1501
150-lb. R-P&C
Cast Steel
Gate Valve

## TOUGH!
## ... but Smooth

● Electric furnace steel is used in making R-P&C Cast Steel Valves. With all parts of equal strength, they are tough. Bodies resist distortion. One-piece yoke is rigid, provides permanent alignment. Gland packing stays tight at high pressures and temperatures. Requires little servicing. Internal design permits smooth flow, positive shut-off.

You'll save money with R-P&C Cast Steel Gate Valves. See your R-P&C distributor or write to the nearest R-P&C district office for information.

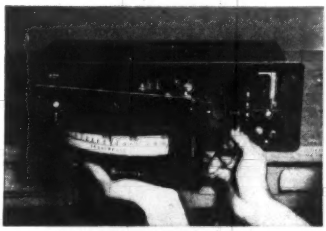
R-P&C valves

ACCO

TRADE MARK

R-P&C VALVE DIVISION
AMERICAN CHAIN & CABLE

Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.



## G-E Pyrometer Equipment Quick and Easy to Inspect, Maintain

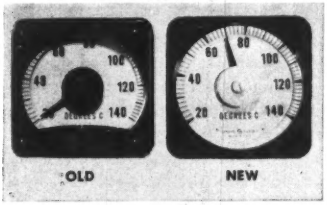
Routine inspections of new General Electric Type HP pyrometers can quickly be made. Besides making preventative maintenance easy, this equipment has many other features to provide accurate indication and temperature control of furnaces, ovens kilns, and other industrial heating equipment.

**ACCURATE WITHIN ¾ OF 1%** full scale, HP-3 pyrometers have automatic cold-junction compensation that adjusts for changes in ambient temperature.

Any change in temperature, even as small as 0.1% full scale, starts immediate control action. Normal changes in humidity, ambient, and voltage have little or no effect on the exactness of control action.

**FOUR TYPES AVAILABLE**—indicating, protecting, two- and three-position control forms; also both flush and surface mountings. All available in a variety of temperature ranges in the 0-3000 F span.

Mail the coupon for complete information about Type HP pyrometers.




## New Shadow-proof Temperature Indicators Are Easier to Read

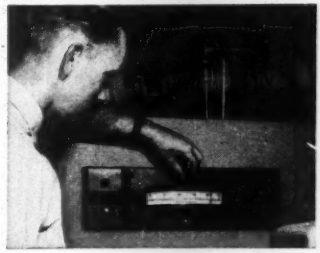
Temperatures from −100 F to +300 F can now be accurately indicated and controlled with General Electric's new line of temperature indicators. These instruments can be read from almost any angle. The dial is set forward, flush with the front of the case. A protruding convex-type glass front provides clear illumination. No more cover overhang; no more shadows caused by overhead lighting. Two sizes available—4¼- and 8¾-inches. Check coupon.

# New Resistance Thermometers Accurately Indicate and Control Low Temperatures

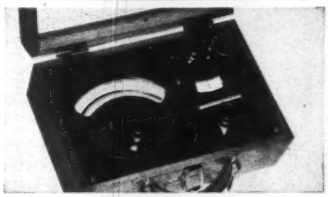
**TEMPERATURES FROM −100F to +300 F** can now be accurately indicated and controlled with General Electric's new line of resistance thermometers. They indicate accurately within ¾ of 1 per cent full scale. Any change in temperature equivalent to 1/10 of 1 per cent full scale starts immediate control action.

Normal changes in humidity or room temperature do not affect the exactness of control. Neither does a change in control voltage. Sturdy, simple construction assures reliable operation under severe operating conditions.

**NARROW TEMPERATURE SPANS,** as small as 90 degrees, are available anywhere in the −100 F to +300 F range. You can buy four types of resistance thermometers—indicators, protectors, and two- or three-position controllers—for either flush or surface mounting.

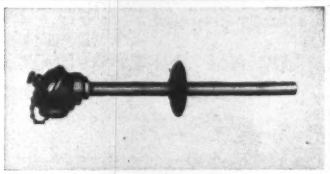


For complete information, mail the coupon below.



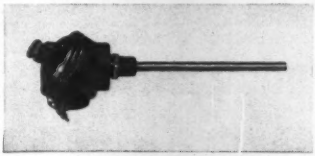
**THERMOCOUPLE POTENTIOMETER** measures temperature in locations inaccessible to glass-stem thermometers. Any number of different readings can be taken in rapid succession and accurate within ±0.2% of full scale.

Typical applications include refrigerator-development work, oil-burner and air-conditioning tests, steam temperature measurements, and heat-run tests on electric equipment. For complete information, mail the coupon below.



**THERMOCOUPLES, COMPONENTS, AND ACCESSORIES** for your pyrometer installations include protecting tubes and wells, thermocouple wire, ceramic insulators, extension wire, connectors, heads, selector switches. Send coupon today for catalog to help you obtain proper thermocouple assemblies.

## Resistance Bulbs Accurate Within ±1 F between −100 F and +300 F



**FOR ANY RESISTANCE THERMOMETER INSTALLATION,** new G-E resistance bulbs offer a high degree of accuracy and reliability. They're available either with completely enclosed terminal head or without terminal head and with four feet of flexible cable. Units will retain calibration within 0.1 F. For complete information, mail the coupon below.

**SECTION N 602-227, GENERAL ELECTRIC, SCHENECTADY 5, N. Y.**

**Please send me the following bulletins: Indicate:**

- √ for reference only
- x for planning an immediate project
- ☐ Resistance Thermometer (GEC-835)
- ☐ Resistance Bulb (GEC-835)
- ☐ Type HP-3 Pyrometer (GEC-713)
- ☐ Temperature Indicators (GEC-2188)
- ☐ Thermocouples, Accessories (GEC-714)
- ☐ Thermocouple Potentiometer (GEC-245)

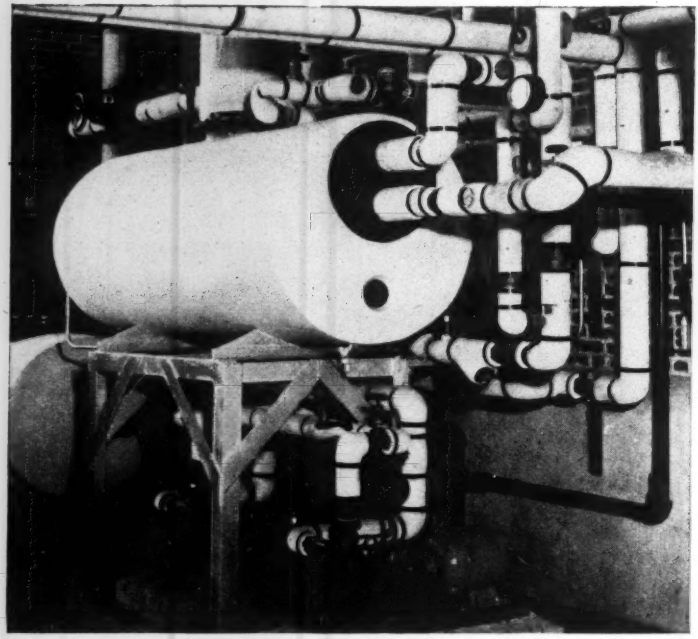
NAME .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

**GENERAL ELECTRIC**



# SCHAUB
## BOILER RETURN SYSTEMS

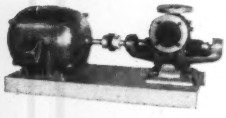
Model S6F Schaub Duplex Deaerator System at the Lawrence Hose Co. (formerly Anchor Thread Co.), Lawrenceville, N. J. Of the 200 H. P. total load, 50% is live steam usage, with 15% returns from a hot water storage heater and 35% returns from high pressure unit heaters.

## Judge on Facts...Prove to Yourself —

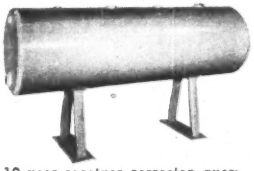
# SCHAUB'S YOUR BUY!

Look at Schaub's three outstanding *exclusive features.* Check them point for point with your own experience. Then you'll realize how much more these *plus values* really mean...and why a Schaub System can actually give you more—in low-cost maintenance, improved operating economy . . . and enduring dependability for many years to come. In short, you can't afford to buy a boiler return system until you know the Schaub story ...then, you won't be satisfied with less.

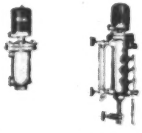
***Only* SCHAUB *Has This Exclusive Combination of Features . . .***



No more periodic pump maintenance! Schaub Master-Bilt Pumps have new, Fleximatic Mechanical seals and permanently lubricated ball bearings. No more water puddles. No more scored shafts. No pump packing or greasing to do—ever!



10-year receiver corrosion guarantee. Schaub engineers worked with leading chemical researchers to develop the Chromosoid lining. You're safe from costly premature replacements. No more rust-clogged systems.



Schaub Systems use only proven super-SAFE Magnetrol pump control and low-water cut off. No bellows to stiffen, no packing to bind, no tricky electrode circuits to fail. Magnetrol's tireless, friction-free magnetic force provides ultra-dependable switching action at all times. BOILER SAFETY KNOWS NO PRICE.

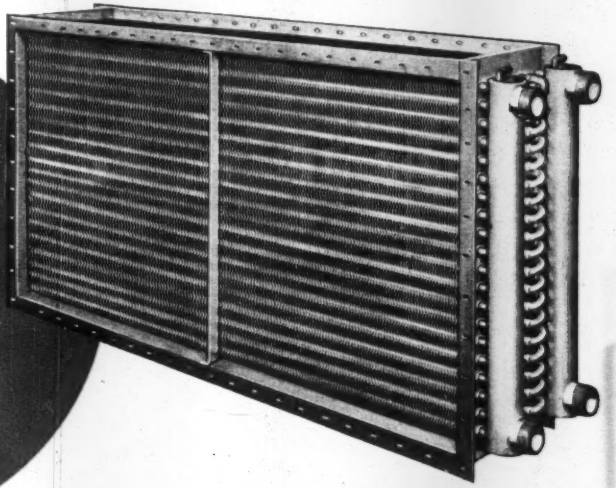
Schaub also builds Patented Heat-Reclaim and Spray-Type Deaerating Systems for exacting requirements from 10 to 1000 Boiler Horse Power. Write for new Schaub Catalog No. 55 which gives more information on all types of Schaub Systems.

**FRED H. SCHAUB ENGINEERING COMPANY**

**2116 S. Marshall Boulevard • Chicago 23, Illinois**

# NEW STANDARD OF QUALITY!

McQuay WATER COOLING COILS

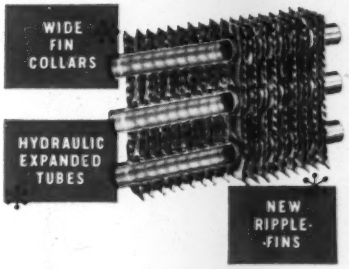


## . . . featuring NEW RIPPLE-FIN CONSTRUCTION

Now, the new, improved Ripple-Fin makes McQuay Water Cooling Coils even more rugged and efficient. Consider these advantages of the new Ripple-Fin Coil construction:

- Easy to drain of condensed moisture. Water hang-up has been sharply reduced on coils requiring vertical (up) air flow.
- Produces a rippled air flow pattern . . . closer and longer contact between the air stream and the coil surface, preventing air by-pass and producing faster heat transfer.
- Permits increased face velocities without danger of moisture carry-over from fin surface to air stream.
- Offers greater heat transfer surface.
- Gives higher flexible strength with minimum air friction and cleaner operation.
- Copper tube headers provide inherent flexibility.
- Hydraulic expansion of all tubes into fins having wide smooth collars assures permanent mechanical bond.

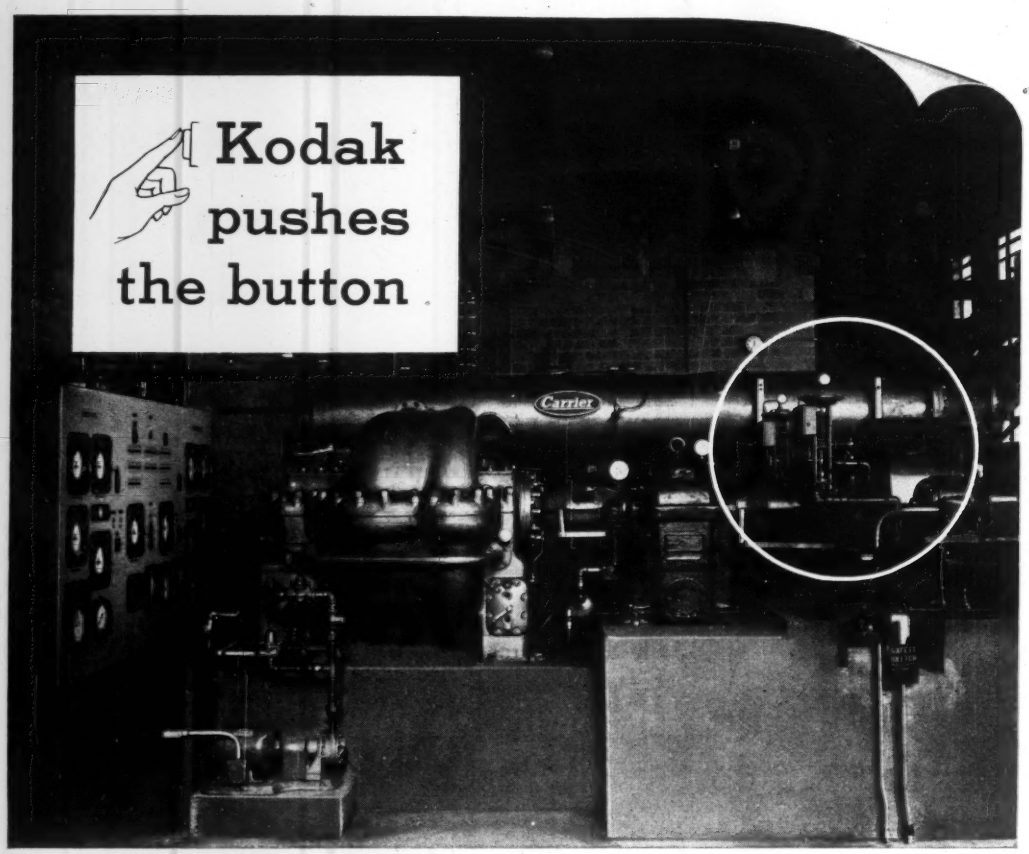
Available in a wide variety of styles and sizes. Standard and special coils for cold water, brine, direct expansion, refrigerant condensing, steam, hot water, and other applications. Write McQuay, Inc., 1601 Broadway St. N.E., Minneapolis 13, Minn. Representatives in principal cities.




EXCLUSIVELY YOURS IN McQuay COILS!

McQuay INC.

HEATING • AIR CONDITIONING • REFRIGERATION




# We do the rest . . .

**in controlling the refrigeration system at Kodak's huge new Distribution Center at Rochester, N.Y.**

This center handles practically every Rochester-manufactured Kodak product for storage, packing and shipping in its 476,000 square feet of floor space.

**Air conditioning for storage** of sensitive photographic films and papers is extremely important, and it starts off right with these 250-ton Carrier centrifugal compressors which supply the chilled brine to the Taylor controlled temperature zones . . . "the most fully automatic compressors we ever installed", say Carrier engineers about these Taylor controlled centrifugals.

**Taylor controls keep** the output temperature of the chilled brine constant by regulating the oil volume in the hydraulic coupler (circled) between the compressor itself and a constant speed motor. During periods of minimum load, an ingenious hot gas-by-pass induces a load on the compressors to eliminate surging and keep the system fully automatic. From Friday night to Monday morning, when the load is especially light, the system automatically keeps the brine temperature constant with *no manual attention whatever.*

**No matter what** your air conditioning or refrigeration problem may be, you'll get most efficient operation from your equipment when it's under Taylor Control. Ask your Taylor Field Engineer, or write for **Catalog 300.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

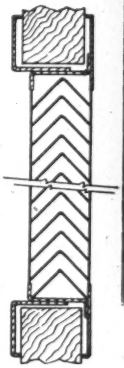
*Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

**Taylor Instruments**
**MEAN**
**ACCURACY FIRST**
**IN HOME AND INDUSTRY**

# NEW DOOR and PARTITION GRILLE

CUTS COST UP TO 35%

NO SEE-THRU



● Cut-a-way view shows new auxiliary frame. Quickens installation—makes a smoother appearance.

**NEVER BEFORE SUCH A DOOR GRILLE FOR THE MONEY.** It's so far ahead in design, construction and performance that it's guaranteed to open your eyes.

Skilled Airfoil designers drew, tested and built it to give architects, contractors and engineers the *finest door grille possible.* It's made to OUTLAST—OUT PERFORM.

First—*it's more rugged.* Will withstand heaviest use and abuse for years and years. Second—*it's low in cost,* competitively priced. Third—*it's good looking.* Will add beauty every time it is installed. Fourth—*louvers are absolutely secure.* Do not rattle when door is slammed.

## Air Foil AIR CONDITIONING OUTLETS

FREE!

- **HEAVY GAUGE STEEL. REINFORCED ON EITHER SIDE.**
- **ADAPTABLE TO ANY DOOR WIDTH...MADE TO ANY SIZE.**
- **73% FREE AREA.**
- **ONE-PIECE FRAME.**
- **CUTS DAMAGE AND REPLACEMENT COSTS. NO EXPENSIVE CALL BACKS.**

**GET THE COMPLETE INFORMATION ON THESE AND ALL AIRFOIL GRILLES TODAY**

**CHECK TYPE OF GRILLE ON WHICH INFORMATION IS DESIRED**

- ☐ Air conditioning outlets
- ☐ Return air grilles and registers
- ☐ Volume controllers
- ☐ Perforated metal and ornamental grilles
- ☐ Industrial grilles
- ☐ Special made-to-order grilles

**TITUS MANUFACTURING CORP., WATERLOO, IOWA**

- ☐ RUSH information on new door and partition Grilles.
- ☐ Send complete catalog.
- ☐ Send literature on above checked items.

NAME_____

ADDRESS_____

CITY_____ STATE_____

# He used his **head** instead of his back!

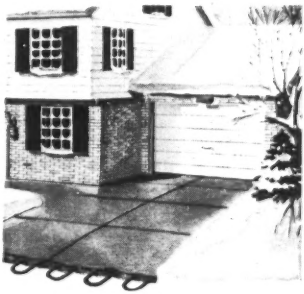
## Steel pipe snow melting systems enhance property values, too!

The most envied man in any block, a few years ago, might have been the one with a new post-war car in his garage . . . or a television antennae on his chimney. But during the last "big snow", thousands of weary shovel wielders would have voted the foresighted owner of a snow melting system just about the luckiest "man of the year."

The complete passing of the snow shovel may still be years away but, more and more, home owners are installing hot water snow melting systems to keep sidewalks, driveways, steps and service areas free of snow and ice all winter long. For these systems steel pipe is naturally first choice!

The durability, adaptability and relative economy of steel pipe helps to put this "automatic snow remover" within the reach of thousands of home owners—less than the cost of an aching back and stiff muscles, or the continued inconvenience of a snow-bound car.

Yes, snow melting is definitely "coming into its own", and remember, the property *with* it always will be a preferred value.



*With a driveway snow melting system the family car is always instantly available for pleasure, business, or emergency use. Steel pipe snow melting keeps Americans mobile!*

Steel Pipe is First Choice

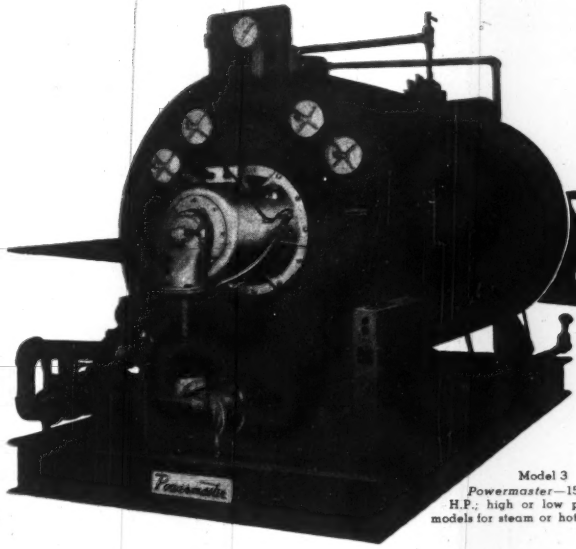
Write for a copy. A free 48-page color booklet "Radiant Panel Heating with Steel Pipe"

**COMMITTEE ON STEEL PIPE RESEARCH**

AMERICAN IRON AND STEEL INSTITUTE

350 Fifth Avenue, New York 1, N.Y.

# reduce your steam costs 3 ways with the automatic Powermaster



Model 3
*Powermaster*—15 to 500 H.P.; high or low pressure models for steam or hot water.

Now you can make your own comparison. No other steam generator gives you all of the *Powermaster's* advantages. A special burner design (patent applied for) reduces your cost of hot water and steam for processing or heating. *Powermaster* is the only self-contained steam generator that offers you—

1. *Full boiler efficiency* at 30% to 100% of capacity. You get fuel savings in slack periods as well as during peak loads.

2. *Less time* (and money) spent for boiler clean-up because of *complete fuel combustion.* (Plant studies show that you clean the *Powermaster* steam generator less than other units under average conditions.)

3. *You take advantage* of low fuel rates by changing from oil to gas (or gas to oil) in a matter of minutes. No fuel shortage worries, either.

***Write for your free copy of this catalog***

It gives you the complete story of the *Powermaster* Steam Generator . . . ease of installation, construction details, automatic controls and fuel saving features. Just write for a copy of Catalog 1218.

## only the Powermaster® gives you all 3 advantages

For heating of plants, institutions, apartments, etc. the *Powermaster* is giving outstanding results throughout the world.

To get firsthand information about this modern steam or hot water generator ask for the address of the installation nearest to you.

**ORR & SEMBOWER, INC.,** *Established 1885*
990 Morgantown Road, Reading, Pennsylvania

# We need 3000 Carloads of Scrap a Day

**Every pound of dormant scrap you can furnish will help to keep the steel mills and foundries producing**

Steel mill furnaces are gobbling up scrap faster than it's being delivered. To maintain planned schedules of steel production for both military and civilian purposes, the mills must have *more* iron and steel scrap.

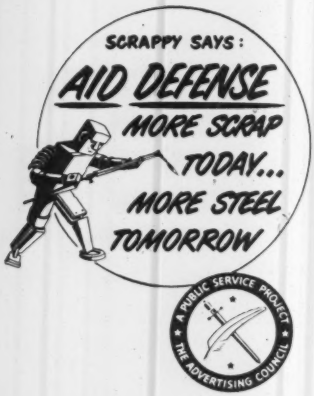
**Get in the Scrap—Yourself!**

Whatever your business, you undoubtedly have scrap. If there's dust on it or rust on it—it may be scrap. If it's scrap—it's *needed.*

Turn it over to your local scrap dealer and help lick this critical scrap shortage.

**What you can do to help**

1. Appoint one top official in your plant to take full responsibility for surveying the plant and getting out the scrap.
2. Consult with your local Scrap Mobilization Committee about its program to help out in the scrap crisis. The nearest office of the National Production Authority, Department of Commerce, can tell you who your local Scrap Mobilization chairman is.
3. Call in your local scrap dealer to help you work out a practical scrapping program. Non-ferrous scrap needed, too!
4. Write for free booklet, "Top Management: Your Program for Emergency Scrap Recovery", addressing Advertising Council, 25 W. 45th St., N. Y. 19.




**FACTS YOU SHOULD KNOW ABOUT STEEL PRODUCTION**

| | | |
|---|---|---|
| Steel production | 1950 | 97,800,000 net tons |
| Estimated capacity | 1952 | 119,500,000 net tons |
| Purchased scrap used* | 1950 | 29,500,000 gross tons |
| Estimated purchased scrap requirement* | 1952 | 36,200,000 gross tons |

*All consumers

***This advertisement is a contribution, in the national interest, by***

## HEATING, PIPING AND AIR CONDITIONING

*Whatever the job you're right with a* **DELCO!**

Whether you need totally enclosed or open-end motors . . . fan cooled or explosion-resistant motors . . . you're certain to get the right motors on the job when you choose Delco.

Each and every Delco motor is designed and built for the job it has to do. It's *made* of the finest materials, and *engineered* to stand up longer under the roughest conditions.

So check up on Delco motors, now. You'll find Delco has the motors you need, and that Delco always meets its commitments. For full details, write to Delco Products, Dayton, Ohio, or call the nearest sales office listed below.

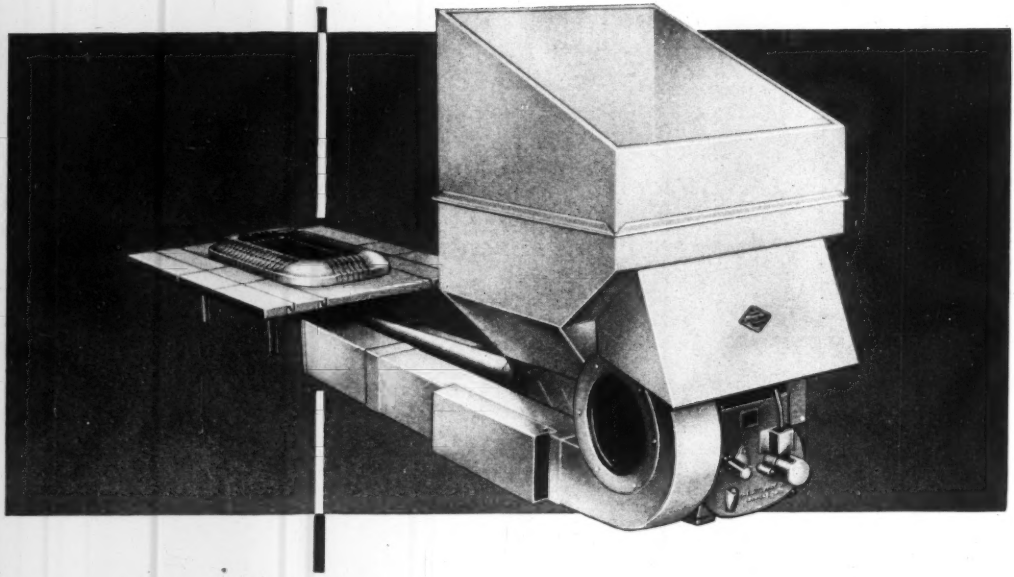
***DELCO FEATURES MAKE DELCO FINEST***

DELCO
DAYTON OHIO

**DELCO PRODUCTS**

Division of General Motors Corporation
Dayton, Ohio

# A WILL-BURT STOKER
## *makes a good coal-heat installation* BETTER

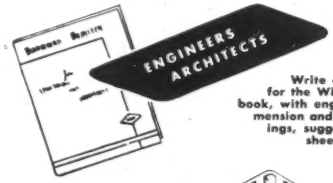


There is no guess-work when you specify or install a Will-Burt stoker. Its design, materials and workmanship are the result of 20 years of field and engineering experience.

The effective, trouble-free Will-Burt automatic air control is one of the important Will-Burt contributions to efficient combustion and smoke abatement. In fact, Will-Burt ***originated*** the application of air control to stokers within the Will-Burt size range. The Will-Burt air-control device has proved its superiority throughout these many years.

The quality which characterizes ***every*** detail of a Will-Burt stoker insures approval by the buyer for him who specifies or installs a Will-Burt. Will-Burt stokers build reputations . . . year after year after year.

They are available in a full range of sizes, hopper and bin fed, in capacities up to 600 pounds per hour.




**Write on your letterhead for the Will-Burt stoker data book, with engineering facts, dimension and installation drawings, suggested specification sheets, etc. Valuable!**

**OTHER WILL-BURT HEATING PRODUCTS**

Gas and oil conversion burners

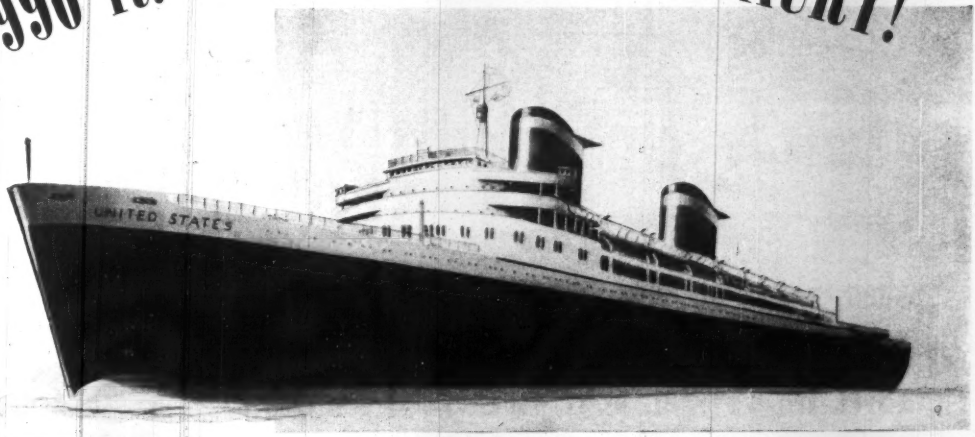
Residential hot-water heating boilers

WILL-BURT

**THE WILL-BURT COMPANY**

**DEPARTMENT H ORRVILLE, OHIO**

# 990 ft. of air conditioned LUXURY!




BARBER COLMAN

uni-flo®

## AIR DISTRIBUTION OUTLETS

## Used in New American Superliner

By the time she goes into service, sometime in 1952, you are going to hear a lot of superlatives about the *S. S. UNITED STATES* — the "biggest, fastest, safest luxury liner ever built in this country." Not the least of these is the fact that it is the first superliner to be *air-conditioned throughout* — and the fact that the combination ceiling light and air diffusers are UNI-FLO special designs engineered and built by Barber-Colman. As with any job of this sort, it took a lot of collaborative effort on the part of Barber-Colman engineers, the ship's architects, the owners' representatives, and the ship builders to reach mutually satisfactory conclusions, but Barber-Colman representatives showed they had the skill and knowledge to cooperate on such a program to a successful result. When *you* travel on the *S. S. UNITED STATES* you will travel in new luxury, thanks in part at least to Barber-Colman and UNI-FLO.

The UNI-FLO line of air distribution outlets is a broad one, encompassing units for almost every purpose in any type of building. Write for copies of the comprehensive literature we have on this subject — or let one of our engineers call and discuss your particular problems in detail.

NATION-WIDE SALES AND ENGINEERING SERVICE

**BARBER-COLMAN COMPANY, 1228 ROCK ST., ROCKFORD, ILL.**

**Venting problems**

*meet their match*

**. . . when you install**

# TRANSITE INDUSTRIAL VENT PIPE

IF YOU HAVE a tough venting problem, the chances are good that you can solve it with Transite* Industrial Vent Pipe.

That's because this durable asbestos-cement product has proved in many installations that it can successfully resist many of the corrosive fumes, vapors, dusts and gases encountered in industrial venting operations. Its unusual chemical stability may help you realize important savings in plant maintenance . . . help you avoid frequent, costly replacements in your venting system.

Moreover, because Transite Industrial Vent Pipe is nonmetallic and therefore rustproof, it needs no painting or other protective treatment. Highly weather-resistant, it can be used for either indoor or outdoor service. A complete range of sizes up to 36" in diameter, with a complete line of rustproof, corrosion-resistant Transite fittings, adapts it to practically any job requirement. It is light in weight and can be readily cut and drilled with ordinary tools.

For further information address Johns-Manville, Box 290, New York 16, N. Y. In Canada, 199 Bay Street, Toronto, Ontario. Ask for Data Sheet Series DS-336.

*Transite is a Johns-Manville registered trade mark

JM

**Typical Industries in which Transite Industrial Vent Pipe is used:**

| | | |
|---|---|---|
| Aircraft | Foundry | Pulp & Paper |
| Automobile | Furnace | Quarrying |
| Baking | Furniture | Railroad |
| Bleaching | Gas | Rayon |
| Boiler Works | Glass | Refrigeration |
| Brewing | Laboratory | Rubber |
| Canning | Laundry | Shipbuilding |
| Ceramic | Leather | Shoe |
| Chemical | Match | Smelting |
| Dairy | Meat Packing | Soap |
| Drug | Metal | Soft Drink |
| Electrical | Mining | Sugar Refining |
| Explosives | Paint | Textile |
| Farm Machinery | Petroleum | Tool |
| Food | Potash | Water & Sewage |

**Johns-Manville**

**TRANSITE Industrial Vent PIPE**



*for*

# SPECIFICATION

*and*

# BUYING INFORMATION

***Use your complete, up-to-date***

## *JANUARY DIRECTORY ISSUE*

**Your job will be a lot easier if you'll keep the January Directory issue of Heating, Piping & Air Conditioning constantly available for handy reference. It's one of your most valuable tools — one which will save you many hours of looking up the products you need for your various jobs. It's the ONE complete, up-to-date, readily accessible source of product information on who makes the pumps, valves, traps, compressors, specialties of all kinds, etc., you need — and where they're located. They're identified by trade names, too. EVERY product is listed, alphabetically arranged and printed on a distinctive yellow stock for easy reading and reference. Keep it handy . . . the time you save with it can be used to advantage in other ways.**

***. . . here's what other engineers and contractors have to say . . .***

"Your Directory issue is an excellent buyers' guide. We use it a great many times during the course of the year."
*BOSTON ENGINEER*

"We find both Directory and Advertising Section helpful. The advertising gives us the product details we need."
*CHICAGO CONTRACTOR*

"Your directory stays in this office until the next January issue comes along. Numerous times we refer to it."
*FORT WAYNE CONTRACTOR*

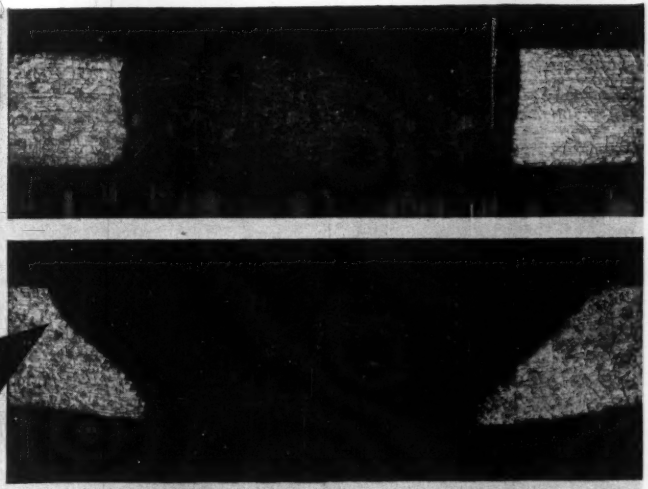
"In our work, we make use of your Directory time and time again. Our reference file would not be complete without it."
*LOS ANGELES ENGINEER*

***REMEMBER — EVERY product is right at your fingertips***

**HEATING, PIPING & AIR CONDITIONING**
**6 North Michigan Ave. Chicago 2, Ill.**

HERE'S WHY

ZALLEA EXPANSION JOINTS



*Top: Weld bead of Zallea Expansion Joint.*
*Bottom: Weld bead of competitive expansion joint.*

# ...Offer You Longer Service Life!

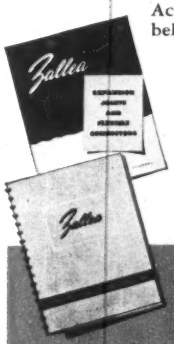
**For years, expansion joint manufacturers have talked in general terms about "quality", "dependability", "economy", and the like.** But these words have no real meaning to you as a user of expansion joints unless they are backed up by facts... and conclusive proof!

When we point out that Zallea Expansion Joints offer you *longer* service life, here's what we mean:

It's an accepted fact that the life of a corrugated expansion joint varies inversely with the thickness of the metal. Therefore it is essential that a corrugated bellows have uniform thickness throughout. Only in Zallea Stainless Steel Expansion Joints are you assured of this optimum condition because Zallea alone produces a longitudinal weld of the same thickness as the parent metal without grinding.

Accelerated flexing tests of many corrugated bellows proved that the resultant welding bead of a shielded arc weld was detrimental to the life of the bellows because failure always occurred across the weld—thickest section of the bellows. Zallea metallurgists analyzed many welding processes and found that by adopting an exclusive variation of the Heliarc process and adding a grain refining procedure to the finished weld, they could produce a corrugated bellows that under brutal flexing tests to destruction, *failed in the parent metal only.*

In over 100 bellows tested with Zallea controlled welding, not one failure occurred within 30 degrees of the weld line. More important was the fact that these bellows lasted as much as *8 times* longer than bellows having a shielded arc welding bead! Compare these two unretouched photomacrographs. See for yourself why it is to your advantage to buy Zallea when you want the best in expansion joints. Zallea Brothers, 816 Locust St., Wilmington 99, Delaware.




*For complete information on all Zallea Expansion Joints, write for Catalog 47. You'll also want a copy of Bulletin 351 for quick reference. Ask for it too!*

Zallea
EXPANSION JOINTS

## *Big scale heating here — and* **MARSH** *throughout every building*

A number of the big, well-built structures of the New York Housing Authority are illustrated here. This is big-scale construction running into millions of dollars — the kind of project that asks for the most critical examination of all equipment entering into it.

In designing the heating for these buildings major emphasis was of course placed on end results: minimized operating and maintenance costs. So it is significant that Marsh Radiator Valves and Traps were used throughout all of these buildings.

The thousands of Marsh valves, traps, vents, and strainers that went into these buildings are performing in that trouble-free way that has won the confidence of the most exacting heating men.

Use Marsh equipment on that next job and you will know why it is first choice for so many important jobs.

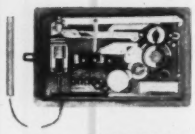
***Ask for new heating catalog 76-H covering all Marsh heating equipment***

**MARSH HEATING EQUIPMENT CO.** Sales affiliate of Jas. P. Marsh Corporation

**Dept. T, Skokie, Ill.**

**MARSH** *Heating Specialties*

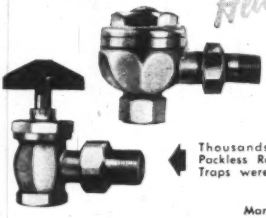
**SINCE 1865**



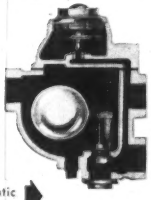
**BIG SAVINGS** *with*

**MARSH** *Tri-Trol regulation*

Maximum comfort at minimum cost when heat is controlled in accordance with outside regulation with Marsh Tri-Trol. Ask for facts.



Thousands of these Marsh Packless Radiator Valves and Traps were used.



Marsh float and thermostatic traps were used throughout.

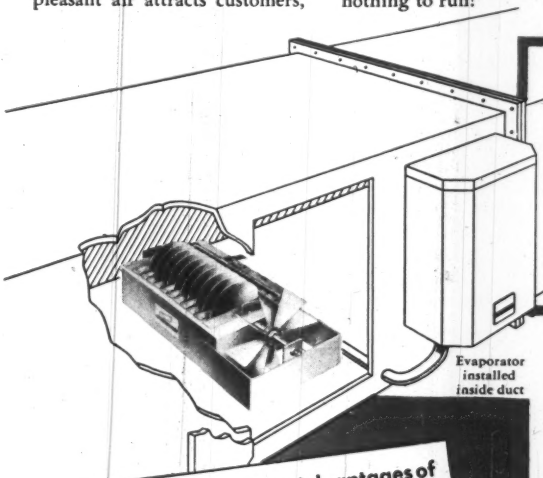
# Revolutionary, Low-Cost
# RENOVAIR GYROSTATIC EVAPORATOR

## maintains pleasant, productive atmosphere!

**Eliminate Costly Odor Problems with this New, Low-Cost Evaporator and...**

**RENOVAIR AIR DEODORIZER**

**Offensive odors can be costly** . . . but RENOVAIR frees the air from even harsh paint and smoke odors, maintains a garden-fresh atmosphere for only pennies a week! Clean, pleasant air attracts customers, keeps employees happy and productive. Yet, RENOVAIR's Gyrostatic Evaporator installs easily in any air conditioning system or unit, provides unfailing supply of RENOVAIR vapors. Costs nothing to run!



Evaporator installed inside duct

### Wherever People Breathe Renovair Fills a Need

- Restaurants
- Theatres
- Stores
- Bowling Alleys
- Washrooms
- Hotels & Apartments
- Hospitals
- Offices
- Schools
- Industrial Plants

**RENOVAIR** neutralizes indoor odors much the same as green foliage freshens the air outdoors. Contains no formaldehyde or chlorophyll . . . will not burn or harm sense of smell. RENOVAIR also performs perfectly from spray guns, fogging machines or wick bottle.

**For Non-Air Conditioned Spaces**
**Use RENOVAIR WICK TYPE DEODORIZERS**
**Just Pull Up the Wick**

12-oz. Bottle Only **79¢**

### Check These Outstanding Advantages of RENOVAIR GYROSTATIC EVAPORATOR

- ✓ PROVIDES UNFAILING SUPPLY OF RENOVAIR VAPORS
- ✓ SIMPLE TO INSTALL
- ✓ COSTS NOTHING TO RUN
- ✓ NO ELECTRIC POWER REQUIRED
- ✓ REVOLUTIONARY DESIGN
- ✓ WORKS SILENTLY

**SEND FOR FREE FOLDER!**

**BOYLE-MIDWAY INC., Correctair Division**
**22 E. 40th St., New York 16, N. Y.**
**Cranford, N. J., Chamblee, Ga., Chicago, Los Angeles, Toronto**

**Boyle-Midway Inc., Correctair Division**
**22 E. 40th St., New York 16, N. Y.**

Please send me FREE folder of performance data, installation instructions and technical information on RENOVAIR and the GYROSTATIC EVAPORATOR!

Name_____

Firm_____

Address_____

City_____ Zone____ State_____

# JENKINS PRACTICAL PIPING LAYOUTS 58

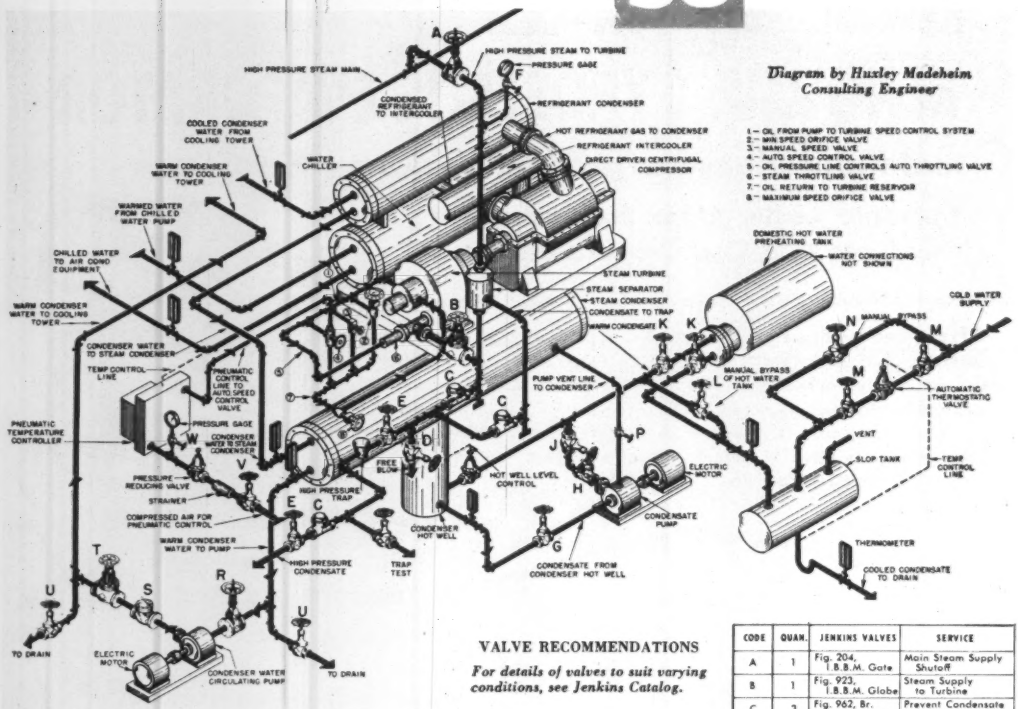



*Diagram by Huxley Madeheim, Consulting Engineer*

**VALVE RECOMMENDATIONS**

*For details of valves to suit varying conditions, see Jenkins Catalog.*

| CODE | QUAN. | JENKINS VALVES | SERVICE |
|---|---|---|---|
| A | 1 | Fig. 204, I.B.B.M. Gate | Main Steam Supply Shutoff |
| B | 1 | Fig. 923, I.B.B.M. Globe | Steam Supply to Turbine |
| C | 3 | Fig. 962, Br. Swing Check | Prevent Condensate Backflow |
| D | 2 | Fig. 970, Br. Globe | Free Blow and Trap Test |
| E | 2 | Fig. 280, Br. Gate | Trap Shutoff |
| F | 1 | Fig. 703, Br. Needle | High Pressure Steam Gage |
| G | 1 | Fig. 370, Br. Gate | Condensate Pump Shutdown |
| H | 1 | Fig. 92, Br. Swing Check | Prevent Condensate Backflow |
| J | 1 | Fig. 106-A, Br. Globe | Condensate Pump Control & Shutoff |
| K | 2 | Fig. 370, Br. Gate | Preheat Water Tank Shutoffs |
| L | 1 | Fig. 106-A, Br. Globe | Preheat Tank By Pass |
| M | 2 | Fig. 370, Br. Gate | Cold Water Shutoff Valves |
| N | 1 | Fig. 106-A, Br. Globe | Manual By Pass |
| P | 1 | Fig. 741-G, Br. Needle | Condensate Vent |
| R | 1 | Fig. 253, I.B.B.M. Gate | Condensate Water Shutoff |
| S | 1 | Fig. 339, I.B.B.M. Swing Check | Condenser Water Pump |
| T | 1 | Fig. 162, I.B.B.M. Globe | Condenser Water Flow Control |
| U | 2 | Fig. 106-A, Br. Globe | Drain Valves |
| V | 1 | Fig. 106-A, Br. Globe | Prevent Air Supply Shutoff |
| W | 1 | Fig. 741-G, Br. Needle | Pressure Gage Control |

## *How to plan*

# CONNECTIONS FOR STEAM TURBINE DRIVEN CENTRIFUGAL REFRIGERATION COMPRESSOR

**As shown in the diagram,** steam from high pressure mains passes through an automatically controlled steam throttling valve which varies turbine speed in accordance with the load on the air conditioning system.

**Control is based upon the temperature** of the chilled water leaving water chiller. A pneumatic controller, positioned by a temperature element in the chilled water discharge pipe, controls air pressure on a diaphragm valve in the oil pressure system.

**This valve controls the pressure** on the steam throttling valve, changing speed of the turbine in accordance with air conditioning load. Exhaust steam from turbine enters the steam condenser which maintains a very low back pressure (26" to 28" vacuum).

**Where district steam is used,** it is generally uneconomical to return the condensate to the boilers; condensate is merely discharged to the sewer after some of the heat has been used to preheat domestic hot water for the building. Local codes specify maximum heat of discharge.

**Jenkins Valves listed** are rated for an assumed high steam pressure of about 160 psi, and the condensing water pressure of about 200 psi.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

### TO SIMPLIFY PLANNING

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the Jenkins Catalog. It's your best assurance of lowest cost in the long run. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal.

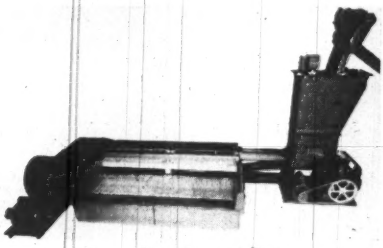
**COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST. Includes additional detailed information. Simply ask for Piping Layout No. 58.**

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864
TRADE JENKINS MARK
Jenkins Bros

# EQUIPMENT DEVELOPMENTS...

### Commercial Hard Coal Stoker

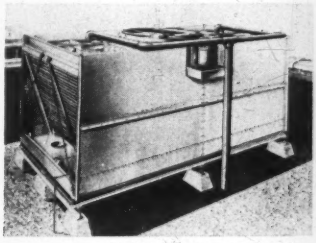
HPAC 1—"Crossfeed" commercial and light industrial automatic anthracite burner available in capacities of either 200 or 300 lb per hr — Motorstoker Div., Hershey Machine & Foundry Co., Manheim, Pa. All moving parts are outside the boiler, away from the high temperature zone. Feed rate adjustments are made from the outside



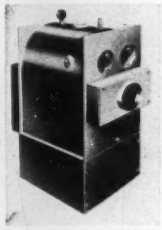
of the unit, without disturbing the fire, and operating power requirements are low, according to the company. There is a positive overload release for protection against damage. The unit can be mounted on either side of the boiler, in single or double installations, and may be equipped for either bin or hopper feeding.

### Cooling Tower

HPAC 2—"Double-Flow Aquatower", a medium capacity range water cooling tower which incorporates one fan that utilizes air from two completely open sides — The Marley Co., Inc., 222 W. Gregory Blvd., Kansas City 5, Mo. Available in seven standard sizes starting with a 50 ton unit, it can be used in the power, petroleum, gas, chemical processing, food processing and metalworking industries, where air conditioning and refrigeration are needed. Height is minimized (7½ ft for the 150 ton unit), pumping head and required fan horsepower are low, and all parts are readily accessible for maintenance and inspection, the company states. The tower is available in all steel or wood with asbestos cement board casing.



Cooling Tower



Water Heater

### Water Heater

HPAC 3**—Automatic gas or oil fired water heater, designed to deliver 300 to 1500 gph of hot water (omitting need of separate storage tank) and incorporating twin coils which deliver water at dual temperatures where necessary — Portmar Boiler Co., Inc., 193 Seventh St., Brooklyn 15. It is rated at 100 deg rise with boiler temperature at 180 F. Temperatures of 227 F maintained in the heater increase capacities 100 percent, according to the manufacturer.

### Window Type Room Air Conditioners

HPAC 4—New line of window type room air conditioners in 1/3, 1/2 and 3/4 hp sizes — Radio Corp. of America, Front & Cooper, Camden, N.J. The 1/3 hp model is rated by the manufacturer at 4200 Btu per hr, for rooms up to 230 sq ft, with an air discharge velocity of 470 fpm. It is designed to remove 1.3 pints per hr of moisture from the air. Corresponding ratings for the 1/2 hp model are 6100 Btu per hr for rooms up to 325 sq ft, air discharge velocity of 560 fpm, and moisture removal

*For your convenience in obtaining more information about any of this equipment, use this coupon. Add the new products and companies listed here to your Directory Section which you received in your January 1952 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.*

**FOR YOUR CONVENIENCE** [2-52]

**Heating, Piping & Air Conditioning**
**6 N. Michigan Ave., Chicago 2, Ill.**

**Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature**

*(Circle each HPAC number in which you are interested)*

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | | | | | | | | | | |
| 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 |
| 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | | | | | | |

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

of 1.75 pints per hr. The 3/4 hp model is rated at 8100 Btu per hr for rooms up to 485 sq ft, air discharge velocity rate adjustable from 510 to 700 fpm, and moisture removal of 2.5 pints per hr. Compressors are hermetically sealed and grilles are adjustable.

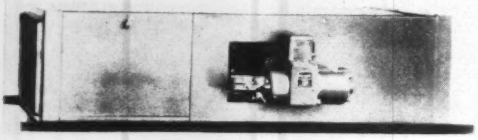
Above: Conditioner
Right: Valve

### Temperature Relief Valve

HPAC 5—No. 201 temperature relief valve, of the automatic reseating type, for hot water tanks and heaters — McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18. Listed by the AGA for heat input up to 1,200,000 Btu per hr, the valve incorporates an hermetically sealed thermostatic element containing a chemical mixture of organic and metallic particles which expand and contract in response to variations in temperature. The internal forces created open the valve orifice at 188 F, and close it "driptight" when the temperature drops to 183 F, the manufacturer states. Maximum valve capacity is 208 F. A fixture connection added to the valve (in addition to the inlet and drain connections) enables the service flow to pass around the element with every demand for hot water. According to the company, this reduces lag in temperature between the water in the tank and the actuating part of the valve, and eliminates any air pocket. The valve is designed for operating pressures up to 125 lb.

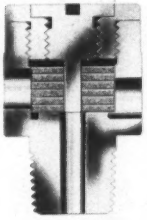
### Suspended Furnace

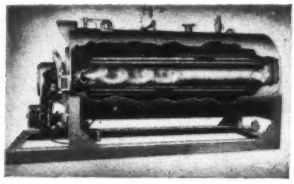
HPAC 6—New 75,000 Btu oil-fired suspended furnace, designed for service stations and other applications in which space is at a premium — Quiet Automatic Oil Burner Corp., 33 Bloomfield Ave., Newark, N.J. It is installed in attics, basements or crawl spaces. The heater also is available in 85,000; 142,000; 175,000; and 200,000 Btu models.



### Steam Air Valve

HPAC 7—Silent air valve for steam heating systems, measuring 3/4 x 1 in., and utilizing special composition discs for operation — Taco Heaters, Inc., 137 South St., Providence 3. Air is forced out between the discs by steam pressure. As steam enters the valve, the moisture in it starts swelling the discs. The discs are so sized and of such material that they will not completely seal until all air has been forced out and the valve is full of steam. When the thermostat is satisfied and steam subsides, the system may go into vacuum for a few minutes, after which the discs dry and shrink, and are ready for another cycle. The valve can be manually operated where necessary. It is made in one size for all applications (radiators, mains, etc.) and can be installed in any position except upside down.





Above: Generator
Left: Air Valve

### Packaged Steam Generator

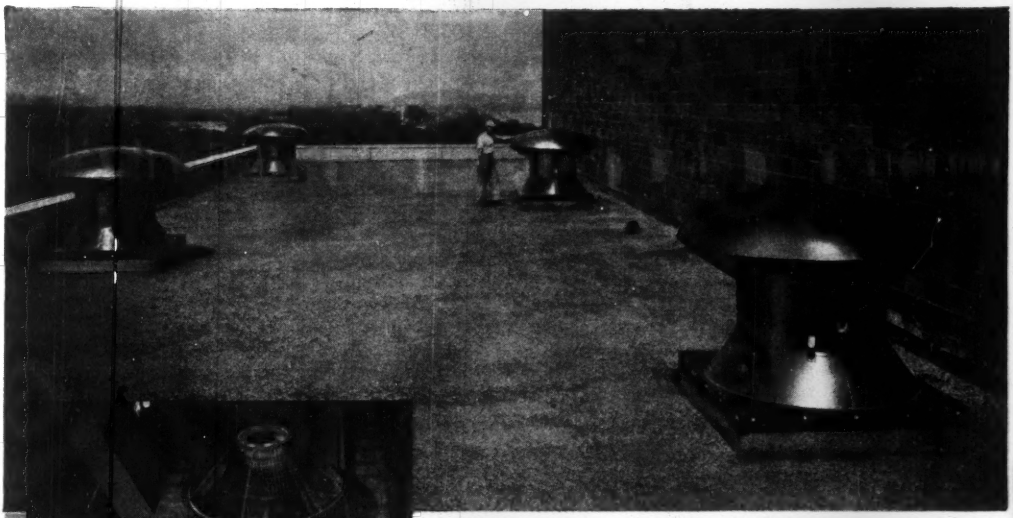
HPAC 8—"Continental" packaged steam generator, for use with heavy oil, light oil, gas, or a combination — Boiler Engineering and Supply Co., Manavon Rd., Phoenixville, Pa. Available in sizes of 10 to 500 hp, for 15 to 200 lb operating pressure, the generator is a fully automatic two pass version of the scotch marine type boiler, this construction being designed to eliminate excess refractory. According to the manufacturer, the front and back of the boiler can be opened in 15 to 20 minutes for interior cleaning and servicing. Efficiency is guaranteed to be at least 80 percent, with steam moisture content under 1 percent. Operation of the burner can be modulated from 35 to 125 percent, the company states. The technique of rotary firing used is designed to condition the fuel and combustion air to produce a uniform fire with high radiant energy.

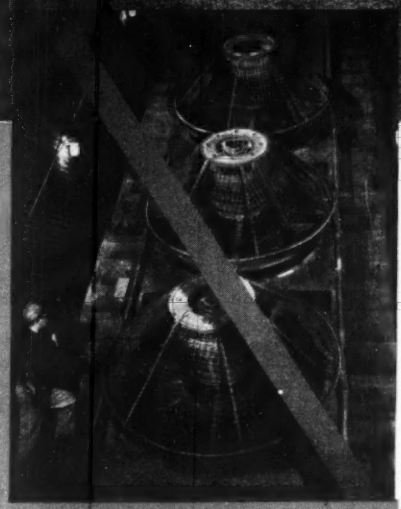
### Baseboard Radiation Unit

HPAC 9—"Basevector" baseboard radiation unit for use in schools, offices, factories, and similar applications — Baseline Mfg. Corp., 3117 N. Washington Ave., Minneapolis 11. The company manufactures both expanded metal enclosures and solid front covers with slotted sloping tops. These enclosures range from 6 to 20 in. in height, so that either one, two or three tiers of core can be installed. If a single core and a 20 in. high enclosure are used, a stack effect is created, increasing the heat output. The steel core or fin tube radiation can be supplied in lengths of from 1 to 20 ft. The circular corrugated fins are mechanically bonded to the pipe (1¼ and 2 in. ID pipe sizes now in production). The manufacturer states that the patented method of putting on a continuous spiral lowers costs of manufacture and the selling price.

### Dehumidifier

HPAC 10—Model D-182 portable dehumidifier with vertical construction (37-7/8 in. tall, 1 ft square) — Mitchell Mfg. Co., 2525 N. Clybourn Ave., Chicago. The unit is designed to remove 17 to 25 lb of water from 10,000 cu ft of air in 24 hours. The 1/8 hp refrigeration compressor operates on a 60 cycle, 115 volt, a-c circuit. The moist air is drawn in through the bottom of the cabinet and passes over evaporator coils cooled by the circulation of "Freon 12". It is then drawn through a condenser which heats it and discharges the dry air at room tempera-





ABOVE: Four DeBothezat 36" Power-Flow Roof Ventilators at Tanners Creek generating station of Indiana & Michigan Electric Co., member of the American Gas and Electric System. Low, streamlined design blends with modern building design. LEFT: Three DeBothezat 6' Vent Sets mounted on a 45° angle.

HOW

# Controlled Ventilation

## SERVES 300,000-kw TANNERS CREEK POWER PLANT

Keeping the air free from coal dust and fumes could have been a serious problem in the Tanners Creek plant. But, here's how the problem was averted:

**FOUR DeBOTHEZAT 36" POWER-FLOW ROOF VENTILATORS** were installed, two as supply units and two for exhaust. These motor-driven fans in weatherproof housings provide positive, controlled ventilation at all times.

**THREE DeBOTHEZAT 6' VENT SETS** with 60 HP motors were also installed. These operate at 700 RPM, each supplying 100,000 CFM of fresh air at 1½ inches S. P. and blowing it to the basement through a vertical shaft. From the basement, air is distributed throughout the boiler and turbine room areas. Eight DeBothezat 48" Vent Sets and two 36" Vent Sets (not illustrated) supply air to various local spots.

*If you have problems of air supply or fume removal, let DeBothezat engineers recommend the most practical, efficient solution.*

DeBothezat Power-Flow Roof Ventilators available with fan wheels 12" through 48" in diameter for use with or without duct systems.

•

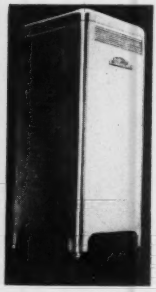
DeBothezat Vent Sets available with fan wheels from 18" to 6' in diameter.

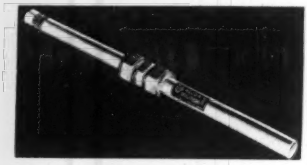
FREE

**ILLUSTRATED BULLETINS** are available on DeBothezat Power-Flow Roof Ventilators and Vent Sets. Ask your local DeBothezat agent or write the factory, Dept. HP-252.

**DeBOTHEZAT**
**FANS DIVISION**
**AMERICAN MACHINE AND METALS, INC.**
**EAST MOLINE, ILLINOIS**

ture for recirculation in the room. Moisture condensed on the coils drops into a catch pan. An 8 qt galvanized moisture receptacle is provided, and drain disposal is possible if desired.





Above: Tube

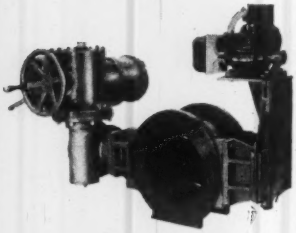
Left: Dehumidifier

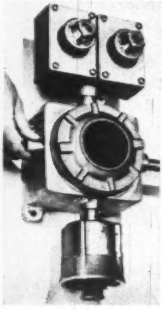
### Aluminum Coiled Tube

HPAC 11—"Utilitube" aluminum coiled tube for use in fuel gas lines for heaters, vacuum and hydraulic lines for instruments, in handling refrigerants (except methyl chloride), etc. — Aluminum Co. of America, 683 Gulf Bldg., Pittsburgh 19. Made of the company's aluminum alloy B50S-0, the tubing is available in lengths up to 1000 ft or more, depending on size. It is low in cost, has good flaring and forming characteristics, and resists vibration and corrosion in many exposures, including industrial and sea coast atmospheres, the manufacturer states. It is also said to improve in mechanical properties at sub-zero temperatures as low as −320 F.

### Valves for High or Low Pressure Drop

HPAC 12—No. 818 valves designed for either a high pressure drop and small volume or a low pressure drop and large volume — R-S Products Corp., 4600 Germantown Ave., Philadelphia 44. The 125 lb cast iron valve illustrated consists of a 12 in. beveled vane which seats against the body side wall with a 4 in. vane mounted in the center of the larger vane; it is used in a turbine bypass line for controlling the required quantity of water when the turbine is not in use or operating at reduced capacity. Both vanes are motor operated. The dual purpose valves are frequently furnished with a small free revolving vane. They are available in various combinations of sizes and for elevated or sub-zero temperatures, with either manual or automatic control.





Above: Valve

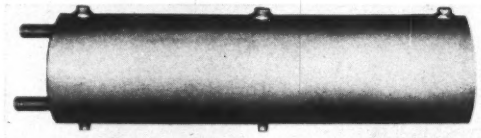
Right: Gas Alarm

### Combustible Gas Alarm

HPAC 13**—Model EE combustible gas alarm, with explosionproof construction, which can be installed directly in the suspected atmosphere, either indoors or out — Johnson-Williams Ltd., 2715 3rd St., Palo Alto, Calif. The sensing unit is located in a bell shaped cover housing and is weatherproof. By convection and diffusion, the atmosphere is subjected to a continuous watch against the build-up of explosive vapors. The presence of such vapors is signalled by a red indicator light and by remote alarm units of various types which can be connected to the terminals provided. Standard alarm point is 0.2 of the lower explosive limit, but other values can be provided. Completely a-c operated, the alarm utilizes an electronic trigger tube circuit to convert the sensing unit signals into alarm indications. Standby power consumption from the 115 volt line is 15 watts.

### Heat Exchangers

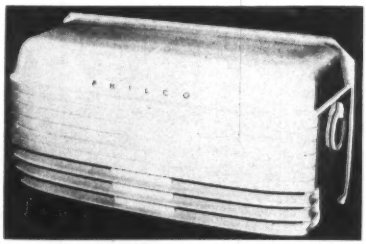
HPAC 14*—"HX-Changer" units for heating and cooling combinations of liquids and vapors — Rempe Co., 340 N. Sacramento Blvd., Chicago 12. The units are shell and coil assemblies having a basic rating of from 98 to 1760 Btu per hr. Typical applications include use as water cooled refrigerant condensers, refrigerant to refrigerant heat exchangers on low temperature cascade and



two stage systems, water chillers using refrigerant as cooling medium, combination water cooled condenser-receivers, etc. The units incorporate a new sub-cooling feature which, according to the manufacturer, promotes high heat transfer efficiency. Coil tubes are copper on all sizes except when made for oil treating, in which case steel coil is furnished. All units are tested to 350 lb pressure.

### Air Conditioners

HPAC 15*—1952 line of air conditioners, consisting of 10 models, including a new 1/3 hp window model (illustrated) for cooling and dehumidifying smaller rooms—

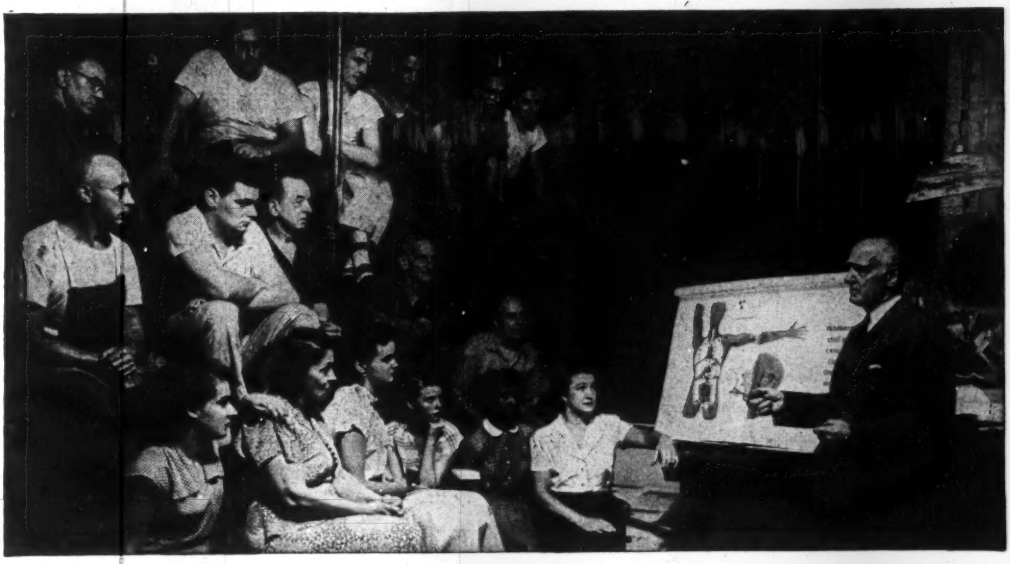



Philco Corp., Tioga and C Sts., Philadelphia 34. Featured is a new automatic temperature control designed to progressively reduce cooling effect as outdoor temperatures decrease. It includes an adjustable thermostat.

### Power Roof Ventilator

HPAC 16—Free exhaust fan roof ventilator designed for rapid localized removal of air contaminated with smoke, fumes, dust and heat — Burt Mfg. Co., Dept. HP, 927 S. High St., Akron 11. It is powered by an axial flow

(*Continued on Page* 186)



## On the job!

Our volunteer speakers are saving thousands of lives *today* . . . in factories and business offices . . . at neighborhood and civic centers . . . at social, fraternal and service group meetings all over this land . . . by showing people what they can do to protect themselves and their families against death from cancer.

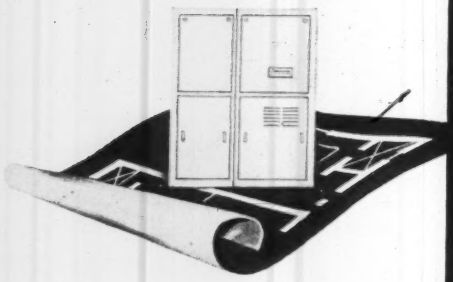
In laboratories and hospitals, from coast to coast, our volunteer dollars are supporting hundreds of research and clinical projects that will save countless more lives *tomorrow*.

To find out what you yourself can do about cancer, or if you want us to arrange a special educational program for your neighbors, fellow-workers or friends, just telephone the American Cancer Society office nearest you or address your letter to "Cancer" in care of your local Post Office. One of our volunteer or staff workers will be on the job to help you.

***American Cancer Society***

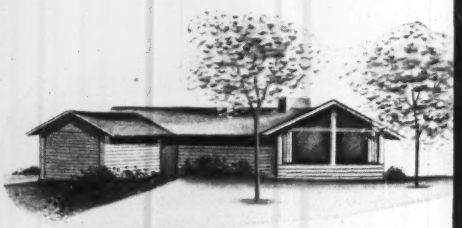
# Would you like to sell an idea?

**The product is the Carrier Weathermaker Air Conditioner. The idea is the Carrier Weathermaker Home . . . a new kind of home . . . built around air conditioning.**



### It's a new idea

The Weathermaker Home is more than an air conditioned house. It's a house that puts air conditioning to work! It's a house that's designed around air conditioning. So that the air conditioning pays for itself out of savings. A more compact floor plan. No screens or storm sash. No attic fans or ventilating louvers.



### It's a cinch to sell

Who are you selling? Architects, builders, and anybody who wants a new house. How do you reach them? Well, we're talking to them in a dozen national publications and we're putting a pretty wonderful 32-page book in their hands at the drop of a postal. So we don't lack for leads. And when it comes to selling, you've got something people want.

### And there are extras

And it's not all residential, because there's also a ready-made commercial market for this Carrier Weathermaker Air Conditioner that heats and cools. It's a natural for better shops and offices where they want the air conditioner tucked out of sight. To top it off, these air conditioners carry the Carrier name.

**CARRIER CORPORATION**
**305 S. Geddes Street, Syracuse 1, N. Y.**

Please send me "How to Have a Carrier Weathermaker Home."

*Name* _____

*Street* _____

*City* _____ *State* _____

**Carrier**

**AIR CONDITIONING • REFRIGERATION**

# HIGH

*For domestic hot and cold water lines you can still use copper — non-rusting, highly resistant to corrosion!*

# LOW

*The use of copper for underground service lines—another place where you need this hardy metal—is not prohibited by government regulations!*

## ...Chase Copper Water Tube is best!

**Made from commercially pure copper,** Chase Copper Water Tube is ideal for hot and cold water lines and underground piping.

**Chase Copper Water Tube,** Type L, hard temper, in 20 ft. lengths and solder-joint fittings are especially adapted for use in new construction. For replacing old rusted-out piping, Chase Copper Water Tube, Type K, soft temper, comes in long 40 and 60 ft. coils that can be snaked behind walls and under flooring.

**For underground installations** use Type K, soft temper, Chase Copper Water Tube. It is ductile; can be bent around obstructions; moves with the earth until the fill settles. Long lengths up to 100 ft. in coils reduce the number of flared fitting connections to a minimum.

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

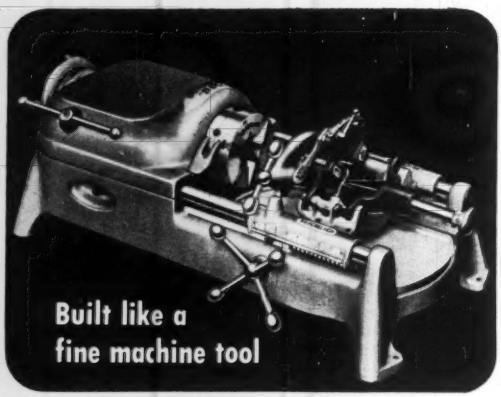
| | | | | | |
|---|---|---|---|---|---|
| Albany† | Cleveland | Kansas City, Mo. | New York | San Francisco |
| Atlanta | Dallas | Los Angeles | Philadelphia | Seattle |
| Baltimore | Denver† | Milwaukee | Pittsburgh | Waterbury |
| Boston | Detroit | Minneapolis | Providence | |
| Chicago | Houston† | Newark | Rochester† | (†sales office only) |
| Cincinnati | Indianapolis | New Orleans | St. Louis | |

# Announcing

THE GREAT NEW

# "500" RIDGID

PIPE & BOLT THREADING MACHINE




## Full of typical RIDGID improvements

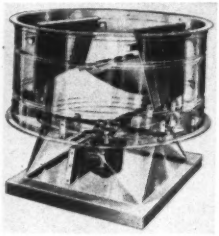
- Range ⅛" to 2" pipe; ¼" to 2" bolts.
- Cutting, threading and reaming tools operate independently and right up to chuck, swing up out of way when not in use.
- New RIDGID quick-opening quadritype, dualtype and monotype die heads save time and work.
- Concealed oil system, reversible pump, no priming.
- More than 20 other efficiency improvements—see this remarkable new RIDGID "500" at your Supply House!

THE RIDGE TOOL CO. • ELYRIA, OHIO

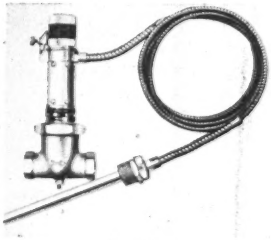
RIDGID
Work-Saver Pipe Tools


(*Continued from Page* 182)

fan connected directly to the motor. The air shaft extends above the fan and terminates in a pair of dampers that open and close automatically as the fan is turned on and off. Their free opening allows an unrestricted volume of air to be driven upward at high velocity by the fan, the manufacturer states. Seven sizes, with motors ranging from 1/3 to 5 hp, provide capacities of 5000 to 75,550 cfm.



Roof Ventilator



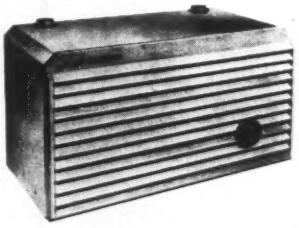
Regulator

### Temperature Regulator

HPAC 17—Type UBA packless, single seated, hermetically sealed, self operated temperature regulator — Farris Stacon Corp., 563 Commercial Ave., Palisades Park, N. J. It is available in ¼, ⅜ and ½ in. sizes for steam pressures to 150 psig, and control of temperature between 30 and 325 F. Control can be applied over a 60 F range. Visual control is provided by a dial adjustment on top of the regulator.

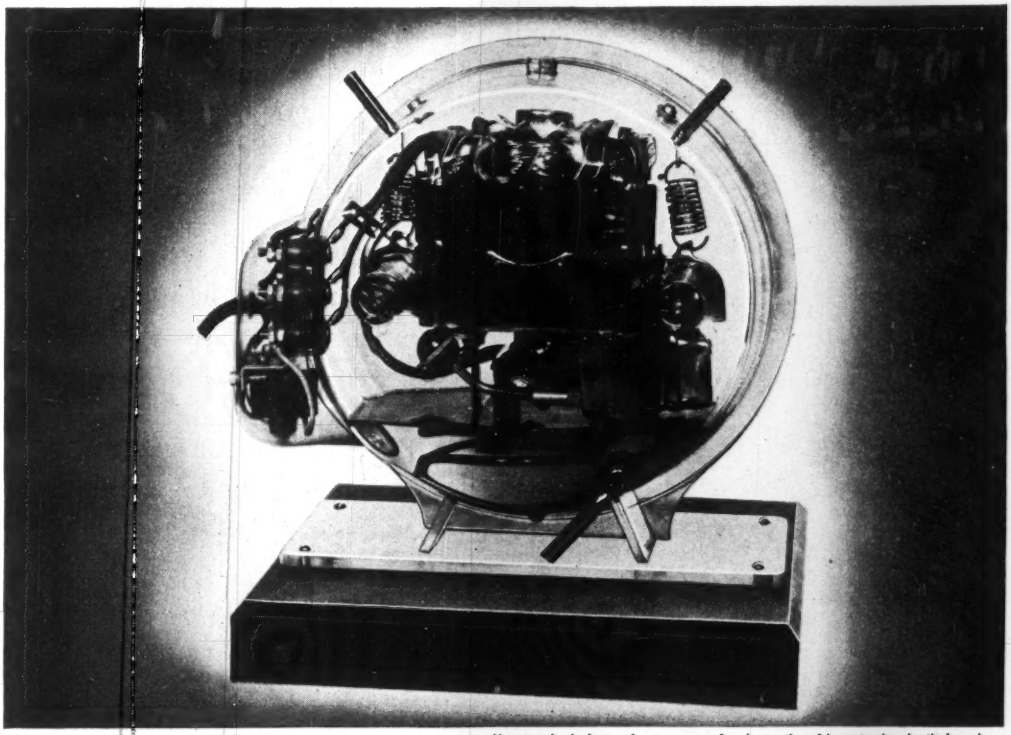
### Room Air Conditioners and Dehumidifiers

HPAC 18—1952 line of room conditioners, including the Model 4 "Roomette" 1/3 hp window unit (illustrated) — Remington Air Conditioning Div., Remington Corp., Auburn, N.Y. The new line also features 1 and 1½ hp "Moisture Magnet" dehumidifiers for commercial and industrial use. The basic design is similar to that of the company's "Leader" model air conditioners, which can be converted to dehumidifier use, and which are now termed "dual purpose units" in the 1 and 1½ hp sizes. The balance of the line includes ½ and ¾ hp window model air conditioners, and 1 and 1½ hp console models.



### $CO_2$ Recorder

HPAC 19—"Condu-Therm" $CO_2$ recorder for use in large industrial power plants and central stations — Hays Corp., 782 E. 8th St., Michigan City, Ind. It utilizes the thermal conductivity principle of gas analysis, and operates electronically. Because of the rapid change of sample gas



Unretouched photo of compressor for domestic refrigerator in plastic housing.

# Inside Story OF THE Outstanding Hermetic Motor

Did you see this *Compressor, with Emerson-Electric Motor, at the Refrigeration and Air Conditioning Exposition?

We don't make hermetic Compressors with plastic housings, but we thought the industry might like to get the inside story of the Emerson-Electric hermetic motor. We provided this special unit so that you could actually see *inside* . . . see the end result of precise manufacturing techniques.

The selection of steel for laminations . . . use of special insulating materials . . . unusual handling of machined parts . . . stator winding in temperature and humidity controlled rooms . . . final testing and sealing for shipment under accurately controlled atmospheric conditions . . . all these are in the Emerson-Electric tradition of precision manufacture.

This is the inside story of America's outstanding hermetic motor. As part of *your* compressor units, Emerson-Electric motors will deliver outstanding performance.

**THE EMERSON ELECTRIC MFG. CO. • St. Louis 21, Mo.**

*Manufactured by Tecumseh Products Co., Tecumseh, Mich.

**Write for these Emerson-Electric Motor Data Bulletins**

Appliance and equipment manufacturers, with applications for motors of 1/20 to 5 h.p., can profitably use these reference guides. Specifications, construction and performance data are included for these motors:

- ☐ M77-A Capacitor-Start
- ☐ M77-B Split-Phase
- ☐ M77-C Integral
- ☐ M77-D Fan-Duty
- ☐ M77-E Oil-Burner
- ☐ M77-F Jet Pump
- ☐ M77-G Blower

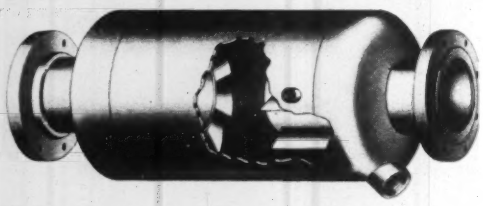
**EMERSON ELECTRIC**
**MOTORS • FANS** **APPLIANCES**

in the gas passage system, the small volume of gas in the analyzing cell, and the continuous connection (through the amplifier) between the analyzer and the recording pen motor, the recorder achieves five second response to changes in the $CO_2$ content of the sample gas, the manufacturer states. It is also said by the company to afford plus or minus 0.25 percent accuracy for chart ranges up to 0 to 20 percent.

### Line Type Purifier

HPAC 20—"Hi-ef" line type purifier for removing entrainment from compressed air, gas, vapor and steam lines — The V. D. Anderson Co., 1935 W. 96th St., Cleveland 2.

Applications in the chemical, petroleum, metal working, and other industries include the prevention of process gas and air lines from becoming contaminated with line scale and liquids, removal of condensate from compressed air lines, delivery of clean, dry steam for food processing, etc.



It is guaranteed by the manufacturer to remove 99 percent of all entrainment. A centrifugal element within the purifier gives the entrainment laden vapor a rapid rotational motion. This causes the heavier entrainment to be thrown outward to the walls of the purifier where it is drained down and ejected. There are no moving parts, and self cleaning action eliminates the need for maintenance, the company states. Sizes are $\frac{1}{2}$ through 24 in. The unit is stamped to ASME Code for unfired pressure vessels. Low pressure line purifiers are not code stamped.

### WE HEAR THAT . . .

Production has started in the new $2 million Van Wert, Ohio, plant of *STERLING ELECTRIC MOTORS, INC.* The plant, which produces gears, splines and gear boxes, is expected to employ approximately 400 people when it reaches full production, scheduled for July. *E. O. DANIELSON*, the company's general factory manager is in charge of the plant, and *B. L. PEAK* is being transferred from the Los Angeles plant to serve as superintendent.

The *ECLIPSE FUEL ENGINEERING CO.* has moved into its new Rockford, Ill., factory and office building, which contains air conditioned offices, an auditorium, and a cafeteria. It occupies 95,200 sq ft, all on one floor, tripling the plant's former quarters. The company's diversified activities are now coordinated in the one building.

*THE LINCOLN ELECTRIC CO.*, Cleveland, paid $4,121,426 to 1082 employees for its 18th consecutive distribution of incentive pay in a year end annual bonus. Each employee, with the exception of the company president, received a check which was, on the average, 104 percent of his regular earnings paid throughout the year.

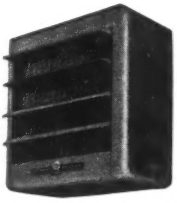

*A unit heater for every need*

from

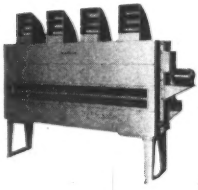
**HERMAN NELSON**

Vertical shaft propeller-fan type unit heater—*especially suited to buildings with high ceilings—up to 50 feet.*

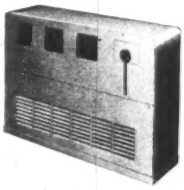
Horizontal shaft propeller-fan type unit heater—*the most generally useful of all space heaters.*



Centrifugal-fan type unit heater—*for efficient heating and ventilating of large industrial spaces.*



De Luxe unit heater—*an attractive, quiet operating unit designed for stores, offices, churches, etc.*



Write for detailed information about any type Herman Nelson Unit Heater to: Dept. HP-2.

AAF

herman nelson moline illinois

**HERMAN NELSON**

*Division of* **AMERICAN AIR FILTER COMPANY, INC.**

MOLINE, ILLINOIS

. . . FROM

# HERMAN NELSON

IN the church shown above, 30 Herman Nelson De Luxe Unit Heaters maintain comfortable temperatures for all services. These versatile units are equally effective for heating stores, offices, markets, display rooms and similar buildings where compact, attractive, quiet-operating heating units are needed.

There are eight models of these unit heaters available for floor, wall, ceiling or recessed installation. All models have an improved "combination type" heating element suitable for either steam or hot water operation. The De Luxe Unit Heater cabinet contains modern styling obtained through superior designing. The absence of projecting parts and its rounded ends contribute to its graceful appearance. The unit is finished in satin-smooth, tan, baked enamel so that it enhances the setting in any application.

Herman Nelson Unit Heaters are ahead of the field because constant engineering development and research plus functional design have earned this position—the result of 45 years of experience in the production of heating and ventilation equipment.

**ALUMINUM CENTRIFUGAL FAN WHEELS** have slow tip speeds for quieter operation.

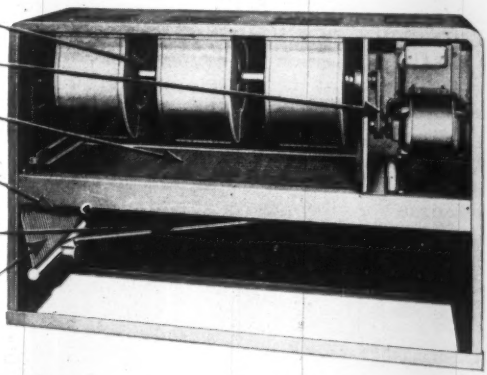
**ADJUSTABLE PULLEY** permits varying performance to meet exact requirements of job.

**CONTINUOUS, NON-FERROUS FINS** are formed with extra wide flange to provide efficient contact between expanded tubes and fins.

**LOOP** in each tube of heating element absorbs difference in expansion and contraction between individual tubes.

**PATENTED, EXTRA HEAVY, RED BRASS STAY TUBE** maintains proper relationship between headers without increasing strain on loops and allows entrained moisture to drain directly from supply to return header.

**ENTIRE TUBE AND LOOP** is fabricated of red brass with no connecting joint to weaken construction.



AAF herman nelson moline illinois

## HERMAN NELSON

*Division of* **AMERICAN AIR FILTER COMPANY, INC.**

**MOLINE, ILLINOIS**

# YOU PAY NOTHING EXTRA FOR UNIBESTOS-TYPE Amocel

## ...THE MAINTENANCE-SAVING PIPE INSULATION

Amocel for commercial uses—like famous Unarco higher-temperature Unibestos—is made from strong, resillient Amosite, the amazing African asbestos. Designed for temperatures up to 600° F., it's a premium product in every way—clean appearance, long life, high efficiency—and it's easy to fit so you save from the first with this better insulation. Made in standard, 1½", and 2" thicknesses for pipe sizes from ½" to 12" in half-rounds with jacket and metal bands. Your Unarco Distributor has Amocel. Call him or write for literature.

- UNHARMED BY MOISTURE, STEAM, OR FUMES
- LIGHT, STRONG—WITHSTANDS IMPACT AND VIBRATION
- MAY BE REMOVED AND REUSED REPEATEDLY WITHOUT DAMAGE OR LOSS OF EFFICIENCY

UNARCO

**UNION ASBESTOS & RUBBER COMPANY**

DEPT. A-2, 332 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

UNARCO

*Distributor of the Month*

**Industrial Insulation Inc.**

311 EAST CARSON STREET

PITTSBURGH 19, PA.

For the past ten years, Industrial Insulation Inc. has served the Pittsburgh Distributing Area. Experienced insulating engineers give careful attention to all requirements. Adequate stocks of Unarco products at a central main warehouse, and at strategically located branch warehouses, facilitate quick delivery.

Many important jobs, both commercial and industrial, have been supplied and installed for the most prominent firms in the district. Capable on-the-job supervision assures correct, economical application.

If you are located in the Pittsburgh trading area, phone Industrial Insulation Inc. for money-saving suggestions and courteous cooperation. The telephone number is easy to remember — HEmlock 1-1234.

**UNARCO Insulations**

PRODUCTS OF

UNION ASBESTOS & RUBBER COMPANY

These checks brought the average total earnings for a worker in 1951 to $7,446. About $300,000 was also allocated by the company for the purchase of annuities for all employees.

Effective this month, *BRUNNER MFG. CO.* is offering a five year protection plan as option, in addition to the standard one year warranty, on its open type commercial refrigeration compressors (1/4 through 10 hp models). Some 23 air and water cooled models come under this service protection. The open type compressors in the 3, 5, 7½ and 10 hp self contained floor type air conditioners also will be offered with the new policy. Distributors and dealers wishing complete details on the plan are asked to write the company, 1821 Broad St., Utica, N.Y.

George F. Frankenberger, William H. Junker and Waldemar A. Lensky, formerly with Wm. W. Carlton & Associates, have announced the formation of the firm of *FRANKENBERGER, JUNKER & LENSKY*, engineers and architects. They remain at 15 East 8th St., Cincinnati.

*BRYANT HEATER DIV., AFFILIATED GAS EQUIPMENT, INC.*, Cleveland, has been elected a member of the *AIR CONDITIONING AND REFRIGERATING MACHINERY ASSOCIATION.*

*BYRON JACKSON CO.*, Los Angeles, is purchasing the assets of the *A. D. COOK PUMP CO.*, Lawrenceburg, Ind. These assets will provide the company with 150,000 additional sq ft of manufacturing space, to be used for the production of centrifugal and vertical turbine pumps.

*PITTSBURGH PLATE GLASS CO.*, Pittsburgh, is purchasing a three year old factory at Shelbyville, Ind., as a manufacturing facility for its new Fiber Glass Div. It is a 147,000 sq ft, one story structure, formerly owned by the National Farm Machinery Cooperative, Inc. A minimum of building change will be necessary to convert the plant, and it is estimated that production will begin by early fall.

An agreement has been reached by which *JOHN WALDRON CORP.*, New Brunswick, N.J., will market the cutout and the cutout coupling of *ANCHOR STEEL & CONVEYOR CO.*, Dearborn, Mich. Both units will be marketed under the name "Anchor-Waldron."

A $2½ million continuous galvanizing plant will be under construction shortly at Martins Ferry, Ohio, for *WHEELING STEEL CORP.*, Wheeling, W. Va. Planned and developed by the company's engineers, it follows principles tested in a pilot plant which has been operated experimentally for a number of months. Large tonnages of galvanized sheets in coils 3000 to 4000 ft in length will be produced.

Construction of a one story factory, with 92,000 sq ft of floor space, has been started in Melrose Park, Ill., for *YEOMANS BROTHERS CO.*, Chicago. Occupancy is scheduled for the fall of this year.

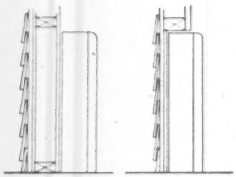
# AIRTHERM Convectors

## Designed for Quick, Easy, Time-Saving Installation

Attractive appearance, outstanding performance and ease of installation have led to an increasing preference for Airtherm Convectors in institutions, apartments, homes and schools
Try AIRTHERM on your next job.
An Airtherm Heating Installation is your assurance of a satisfied customer.

Airtherm Convectors are available for either free standing or recessed installation.

*Write for Catalog 702A for additional information.*



FREE STANDING RECESSED

SEE OUR CATALOG IN SWEET'S

*For Heating Satisfaction . . .*
*Think First of AIRTHERM*

**AIRTHERM MANUFACTURING COMPANY**
711 South Spring Avenue • St. Louis 10, Missouri


To aid its sales representatives in making presentations before societies and technical and trade school groups, *BARBER-COLMAN CO.*, Rockford, Ill., has designed a portable lecture board for automatic electric controls. Using plastic coated equipment photos which are moved about, the board gives the illusion of a fan system and ducting.

A nine minute sound film, *A Winter Wonder*, depicting concealed snow melting systems, has been prepared under the sponsorship of *A. M. BYERS CO.*, Pittsburgh. Copies are offered for showing without charge, and arrangements may be made through the company's main office or branch offices.

*JAMES J. GOODWIN*, who has resigned as general sales manager of Temprite Products Corp., Birmingham, Mich., is now organizing his own sales company with headquarters in Detroit. He will represent manufacturers of refrigerating and heating equipment.

*THE BLACK & DECKER MFG. CO.* is erecting a branch plant in Hampstead, Md., and expects to move several of its work centers from the main plant at Towson, Md., to the new factory, beginning about April 1. The 100,000 sq ft single story building will increase manufacturing facilities by 40 percent.

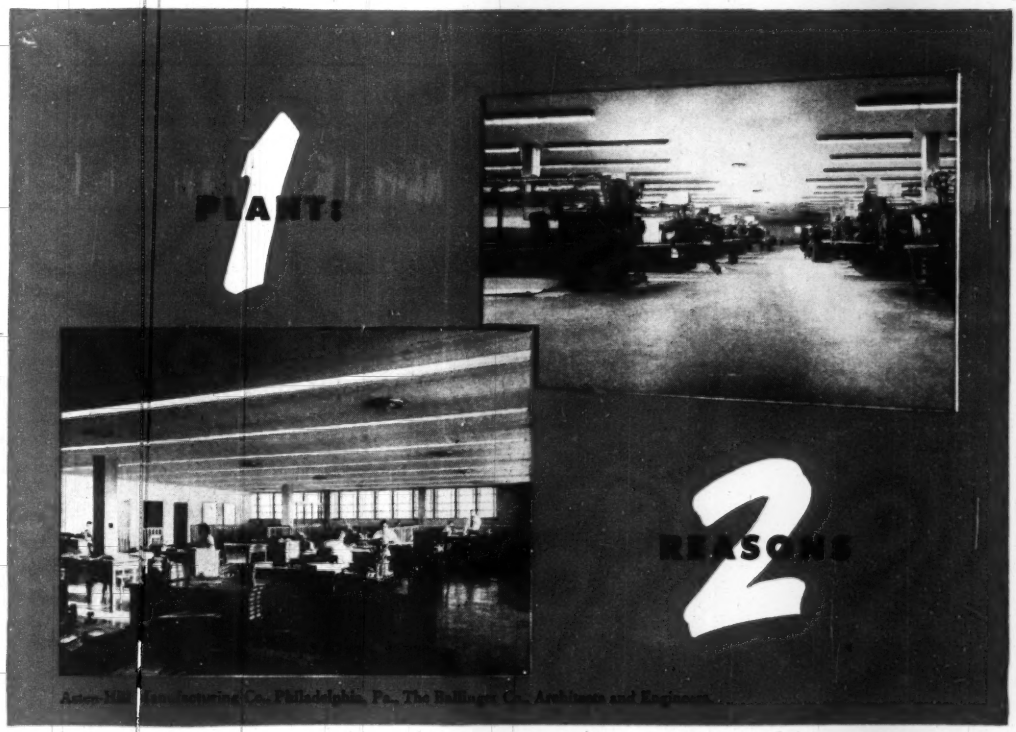
*McDONNELL & MILLER, INC.*, Chicago, held a special training school recently for its district representatives, to acquaint them with the company's new temperature relief valve for hot water tanks and heaters. Sessions were held in the research laboratory.

Local chapters of the *MANUFACTURER'S AGENTS NATIONAL ASSOCIATION* were launched in principal cities with simultaneous meetings held recently. The association is composed of about 1000 agents and manufacturers.

*MANUFACTURERS CORP. OF OHIO*, Mansfield, is a recently formed company which will furnish plastic pipe and fittings to distributors in the heating and plumbing, electrical, plant equipment and other fields. *G. E. LEADBETTER*, formerly with Barnes Mfg. Co., is president, and *WILLIAM R. HITE*, formerly with Johnston Water System Co., is vice president. The pipe and fittings offered are in flexible, semi-rigid and rigid types, in ½ to 6 in. sizes.

An expansion program costing more than $5 million has been started at the Waterford, N.Y., silicone plant of *GENERAL ELECTRIC CO.*, Pittsfield, Mass. The new facilities are scheduled for operation by the end of this year. A Silicone Products Dept. has been formed, and *DR. CHARLES E. REED*, engineering manager, Chemical Div., has been named its general manager.

The rules and conditions for the fifth annual competition of the engineering undergraduate award and scholarship program are now available from the sponsor, *LINCOLN ARC WELDING FOUNDATION*, Cleveland 17, in a 24 page booklet.




Aster-Hill Manufacturing Co., Philadelphia, Pa., The Ballinger Co., Architects and Engineers

# for choosing **kno·draft** adjustable air diffusers

Office space and manufacturing areas in this new asbestos dryer felt plant posed separate problems in air conditioning. In the manufacturing section, the vital factor in diffusion was the *even distribution* of the thoroughly conditioned air. Kno-Draft *Adjustable* Air Diffusers got the call because of their demonstrated efficiency in similar critical installations.

In offices and other employee quarters, beauty as well as efficiency had to be considered. Here again, Kno-Draft *Adjustable* Air Diffusers were selected. In addition to their unobtrusive harmony with any surroundings—from severely plain work areas to paneled directors' rooms — they assure the comfort of *draftless* air distribution.

Another big reason for choosing Kno-Draft *Adjustable* Air Diffusers for every job is their adjustability *after* installation. This means exactly the right balance of temperature and air distribution throughout the area for user comfort . . . and saves engineer and installer a vast amount of preliminary figuring. There are types and sizes of Kno-Draft *Adjustable* Air Diffusers to meet all requirements.

**NEW EDITION!** KNO-DRAFT DATA BOOK now in new 32-page format. Complete up-to-the-minute engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. Bring your files up to date. Mail coupon today.

TRADE MARK "KNO-DRAFT" REG. U. S. PAT. OFF.

**W.B. CONNOR ENGINEERING CORP.**
Danbury, Connecticut
*Air Diffusion • Air Purification • Air Recovery*
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

**W. B. CONNOR ENGINEERING CORP.**
**Dept. G-22, Danbury, Connecticut**

Please send me the *new edition* of the Kno-Draft Data Book—without obligation, of course.

Name .....

Position .....

Company .....

Street .....

City ..... Zone ..... State .....

**Vitrohm enamel gives higher watt ratings**

Save space...save time...use Ward Leonard's AXIOHM resistor.

No nuisance of lugs, screws, bolts. Axial leads are the only mounting support needed—easy to cut, shape and solder. Tough, too—can't come loose or pull apart.

Coating is Ward Leonard's famous *Vitrohm*. High heat dissipation—withstands thermal shock, vibration and corrosive atmosphere.

For "close quarters" applications, specify AXIOHM. Made in 5 and 10 watt sizes.

Write for Catalogue. WARD LEONARD ELECTRIC Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

**WARD LEONARD ELECTRIC COMPANY**

Result-Engineered Controls Since 1892

RESISTORS · RHEOSTATS · RELAYS · CONTROL DEVICES

# WHO'S WHAT

*W. B. HOLTON, JR.* has been elected chairman of the board, *WALWORTH CO.*, New York, and *ALFRED J. EICHLER* is the new president and chairman of the executive committee. Mr. Holton has been a member of the board since 1925, and was elected president in 1936. Mr. Eichler has been vice president in charge of sales for a number of years.

*WILLIAM F. CAROLAN* has been appointed general sales manager of the newly created air conditioning department, *RCA VICTOR DIV., RADIO CORP. OF AMERICA*, Camden. For the past two years he has been sales manager of the E. B. Lathan Co. *E. BURT CLOSE* has joined the division's consumer products advertising and sales promotion department, where he will be in charge of advertising for air conditioners. He has been engaged in merchandising and sales promotion work for the Sun Oil Co.

*H. J. PREBENSEN* has been elected president of *AIR COMFORT CORP.*, which has been identified with Carrier air conditioning in metropolitan Chicago since 1934. Formerly vice president and general manager, he succeeds *H. E. WHEELER*, who has retired from business and will reside in Jamaica, B.W.I. *DICK RODDEWIG*, a director of the company and its tax consultant for 10 years, is the new vice president and treasurer, and *D. A. FORBERG*, chief engineer since 1941, is now vice president in charge of engineering, contracting and servicing operations.

At its recent annual convention, the *NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION* elected new officers for 1952. They are *W. D. REDRUP*, Majestic Co., president; *C. B. PHILLIPS*, Surface Combustion Corp., first vice president; and *G. W. DENGES*, The Williamson Heater Co., second vice president. Reelected for a second term as members of the board of trustees were *R. M. COOK*, Thatcher Furnace Co.; *H. G. CROSS*, Waterman-Waterbury Co.; *M. I. LEVY*, Viking Air Conditioning Corp.; and *L. S. REDFORD*, Jackson & Church Co. *T. I. BYRD*, Lau Blower Co., replaces Mr. Denges on the board.

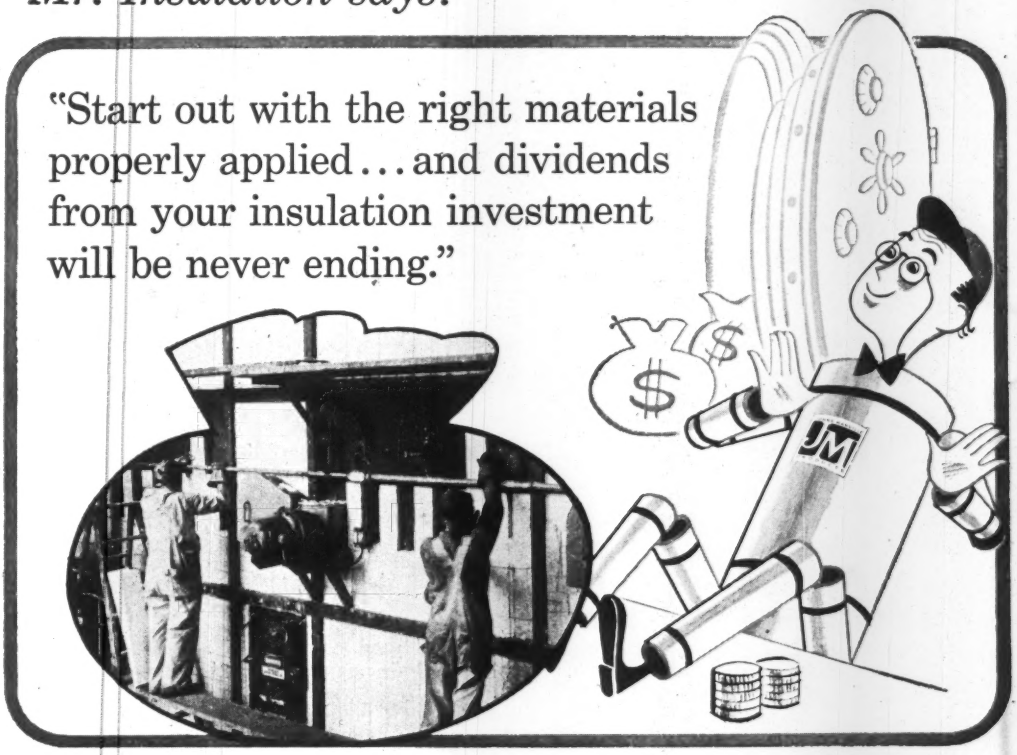
*THEODORE M. DILLAWAY* and *GEORGE B. KELLOGG* have been elected assistant vice presidents of *BUFFALO FORGE CO.*, Buffalo. Both have been with the company since 1940, Mr. Kellogg most recently as assistant production manager at the Buffalo factory, and Mr. Dillaway as assistant secretary, credit department.

*HENRY H. RUSSELL*, formerly a process engineer with Blaw Knox Construction Co., is now a development engineer on the Pittsburgh staff of *BITUMINOUS COAL RESEARCH, INC.* He will be primarily concerned with improving coal utilization, and will assist in the preparation of publications and act as technical assistant to the vice president and director of research.

The vice president of *THE BABCOCK & WILCOX CO.*, New York, *J. H. KING*, has been named to head the reorganized boiler division of the company, which now

*Mr. Insulation says:*

"Start out with the right materials properly applied... and dividends from your insulation investment will be never ending."




Here are two important reasons why it will pay you to let Johns-Manville serve as your insulation headquarters:

YOU GET THE RIGHT MATERIALS—Regardless of the service conditions on your job, Johns-Manville has an insulation that fits the need. That's because Johns-Manville manufactures a wide variety of insulations of asbestos and other selected raw materials—for service from 400F below zero to 3000F above. Johns-Manville offers this complete line because industry requires many types of insulations and because no one material can properly serve as a jack-of-all trades for use on all jobs.

YOU GET THE RIGHT APPLICATION—Insulations serve at top efficiency only when properly applied. J-M Insulation Contract Firms have men with generations of insulation experience and training in Johns-Manville application methods. The way they engineer your job is your assurance that your insulation investment will pay a high return through the years.

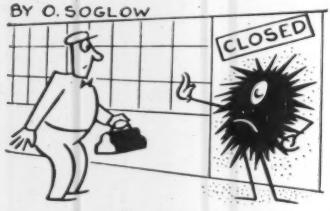
Why not call on insulation headquarters for engineering advice about your insulation work. J-M Insulation Engineers are available to help select the *right* insulation for your particular service conditions. Write Johns-Manville, Box 290, New York 16, N.Y.

JM PRODUCTS

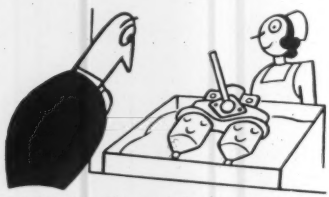
**Johns-Manville** *first in* **INSULATIONS**

# AIR-MAZING FACTS

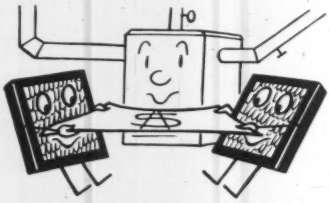
BY O. SOGLOW




**ATOM DUST CLOSES PHOTO PLANT!** Radioactive dust from an atomic explosion in Nevada, carried cross-country by air currents to a Rochester, N. Y., photo film factory, "exposed" and ruined a large amount of stored film there, causing the plant to shut down for 36 hours.



**IT'S TWINS!** No need for shutting down production when oil line filters need cleaning. With a new Air-Maze duplex oil filter on the job you can clean one "twin" at a time, while oil continues to flow through the other.



**DUSTAYS STRETCHES FUEL DOLLARS!** Dirt-clogged filters in your furnace block off air, make your furnace work overtime and use more fuel. Stretch your fuel dollar by replacing dirty filters with new Dustays—the disposable filters that hold more dirt without clogging.

**WHETHER YOU BUILD OR USE** engines, compressors, air-conditioning and ventilating equipment, or *any device using air or liquids* —the chances are there is an Air-Maze filter *engineered* to serve you better. Representatives in all principal cities, or write Air-Maze Corporation, Cleveland 5, Ohio.

**AIR-MAZE**

**The Filter Engineers**

AIR FILTERS
SILENCERS
SPARK ARRESTERS

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS


comprises what was formerly the marine department, and stationary boiler and special products departments. In addition, *LUKE E. SAWYER* and *EDWARD A. LIVINGSTONE*, president and vice president, respectively, of the recently absorbed subsidiary Tube Company (now the tubular products division) have been elected vice presidents of the company. *M. NEILSEN*, since 1950 executive assistant in charge of the contract division, has been elected assistant vice president, and will aid the vice president in charge of manufacturing in the operation of all the boiler division plants.

The new vice president in charge of engineering for *EDWIN L. WIEGAND CO.*, Pittsburgh, is *JOSEPH McORLLY*, chief engineer since 1940. *JOHN W. BAILEY*, personnel director since 1944, has been named vice president in charge of industrial relations. Replacing Mr. McOrlly as chief engineer is *LESTER D. DRUGMAND*, formerly assistant chief engineer.

*JOHN MARSHALL BRILEY* has been elected a vice president of *OWENS-CORNING FIBERGLAS CORP.*, Toledo, where he will assume general executive responsibilities, and will assist in the formulation of corporate policies. He has been a partner in the law firm of Shearman & Sterling & Wright. *E. W. SMITH*, vice president and director of merchandising, has been reassigned as vice president in charge of sales branches and training programs, and *BEN S. WRIGHT*, vice president and general sales manager, has been reassigned as vice president in charge of purchasing and trade relations. In addition, *EDWARD J. DETGEN*, formerly sales manager, Building Materials Div., is now sales manager, General Products Div.

*OTTO J. NUSSBAUM*, formerly chief research and development engineer, has been appointed chief engineer of *KRAMER TRENTON CO.*, Trenton. He succeeds *S. CHARLES SEGAL*, recently named general sales manager.

*JAMES N. CRAWFORD*, for the past seven years director of sales, *BRYANT HEATER DIV., AFFILIATED GAS EQUIPMENT, INC.*, has been appointed assistant to the president of the company. Succeeding him is *W. H. WISE*, who has been assistant director of sales for the division.

The new vice president in charge of sales for *THE TORRINGTON MFG. CO.*, Torrington, Conn., is *DUDLEY B. ROBINSON*, who has been general sales manager.

The vice president and treasurer of *THE EMERSON ELECTRIC MFG. CO.*, St. Louis, *WILLIAM S. SNEAD*, has retired. He will continue to serve as a director of the company. The former vice president and assistant treasurer, *RALPH E. PETERING*, succeeds him, and has also been elected to the board of directors.

*JOSEPH H. HUMBERSTONE* has been elected a vice president of *AIR REDUCTION CO., INC.*, New York. He was formerly president of the company's Airco Equipment Mfg. Div., and has been succeeded in that capacity by *SCOTT D. BAUMER*.

# Inseparable! EASY-FLO and SIL-FOS brazing

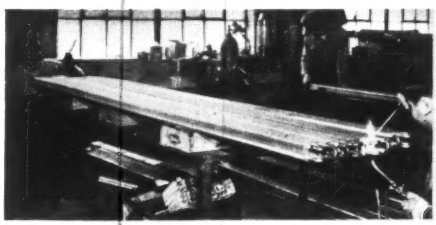
## Fast, low-cost metal joining

In joining metals, you always want strong, lasting joints—and you want them in the fastest possible time with the least amount of labor, because that means low cost.

And that's precisely why you want to braze with EASY-FLO and SIL-FOS wherever and whenever you can—on defense production as well as domestic production. Fast, low-cost metal joining is inherent in the make-up and properties of these low temperature silver brazing alloys.

This is a proven fact. Thousands of manufacturers have done it on an amazing variety of ferrous, non-ferrous and dissimilar metal assemblies. All it takes is proper joint design and alloy application plus a little production-wise planning of the job.

## Just one example



For over 20 years EASY-FLO and SIL-FOS have been favorites for joining pipe and tubing. So it's not surprising to find the Kramer Trenton Co., Trenton, N. J. regularly using SIL-FOS for brazing tubing on refrigerating coils.

They turn out hundreds of coils a week, with 10 to 40 brazed joints per unit—every one brazed with SIL-FOS — and every one meeting a critical water pressure test. SIL-FOS — the low-temperature silver brazing alloy for non-ferrous metals — not only assures strong, permanently leak-tight joints in brass and copper pipe and tubing, but also speed, reliability and economy in making them.

**BULLETIN 17** gives full details about brazing pipe and tubing with EASY-FLO and SIL-FOS. A copy is yours on request.

## *A Brazing Expert is at your call*

Without cost or obligation we'll send to your plant one of our experienced Field Service Engineers. He can tell you if, where and how you can use EASY-FLO and SIL-FOS to advantage. Be assured he will make no recommendation he cannot justify on the basis of better results for you. You can't lose by having him look over your metal joining work. Just contact our nearest office or dealer and say when.

**24 PAGES OF USEFUL BRAZING FACTS IN THIS FREE BULLETIN 20**

If you need leak-tight joints *there's no simpler, faster, more economical way to get them* than with EASY-FLO and SIL-FOS. Bulletin 20 tells *why* and *how*. Write for a copy today.

HANDY & HARMAN · FOUNDED 1867 · QUALITY · SERVICE · ORIGINATORS OF EASY-FLO & SIL-FOS

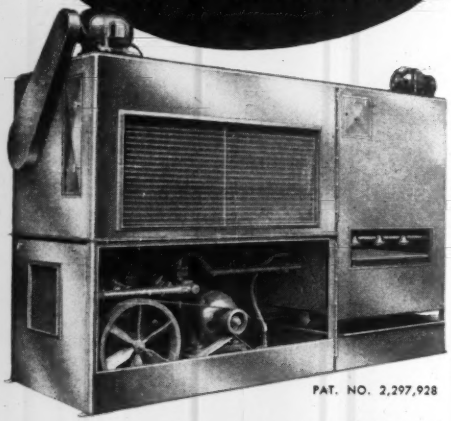
# HANDY & HARMAN

***General Offices: 82 Fulton St., New York 38, N.Y.***

***AGENTS IN PRINCIPAL CITIES***

**OFFICES and PLANTS**
BRIDGEPORT, CONN.
PROVIDENCE, R. I.
CHICAGO, ILL.
CLEVELAND, OHIO
DETROIT, MICH.
LOS ANGELES, CAL.
TORONTO, CANADA

For day in, day out
DEPENDABILITY
you can't beat a
GOVERNAIR
COMPLETELY PACKAGED
AIR CONDITIONER



PAT. NO. 2,297,928

Name your job . . . any air conditioning job requiring from 3 to 50 tons . . . and you'll find that you can't beat a Governair system for day in, day out dependability.

Governair Packaged Air Conditioners are designed to operate at peak efficiency—with all parts precision-matched to work together. And they're built to give years and years of low-cost, trouble-free service.

Choose Governair . . . and you choose the best!

AIR CONDITIONERS | EVAPORATIVE CONDENSERS | COOLING TOWERS | UNIT COOLERS | BLAST COILS FOR HEATING AND COOLING

GOVERNAIR

The newly elected president of the *VENTILATING AND AIR CONDITIONING CONTRACTORS ASSOCIATION OF CHICAGO* is *ROBERT H. WIERSIG*. He succeeds *OTTO A. WENDT*, who has completed four terms as president. Other officers reelected include *J. J. HAINES*, vice president; *P. W. OLMEN*, secretary; and *PORTER R. WEST*, treasurer. Renamed to the arbitration board were *H. JAMES MURRAY*, chairman, and *WILLIAM A. KUECHENBERG*, *D. B. SCHEIDECKER*, and *LOUIS L. NAROWETZ*, who also continue as BCEA delegates. *OTTO A. WENDT*, *G. B. WEBER, JR.*, and *ROBERT R. SEEDORF* were elected members of the board of directors. *L. W. ROGERS* starts his 27th year as executive secretary.

*JOHN H. BARTOL*, director of the air recovery division of the *W. B. CONNOR ENGINEERING CORP.*, Danbury, Conn., has been elected a vice president.

*LYMAN D. WARNER* has been appointed vice president in charge of market & product development and promotion for *AMERICAN DISTRICT STEAM CO., INC.*, North Tonawanda, N.Y. He will handle development and sales of new products, as well as sales of existing lines.

The new assistant treasurer for *McQUAY INC.*, Minneapolis, is *DONALD F. COONES*, who will retain his title as assistant secretary. *BYRON E. JAMES*, who has directed the engineering department, is the new vice president in charge of engineering and research, and *DONALD P. WILSON*, currently in charge of production at the company's three manufacturing plants, is now vice president in charge of manufacturing.

*HERBERT S. HOPKINS* has been named controller of *THE TRANE CO.*, La Crosse, Wis. Formerly, he was associated with Ernst & Ernst, certified public accountants.

*GENERAL ELECTRIC CO.* has appointed *C. G. KLOCK* manager of finance, *AIR CONDITIONING DIV.*, Bloomfield, N.J. Formerly the division's manager of credit and collections, he succeeds *R. E. WHITMYER*, who is joining the company's aircraft gas turbine department at Lockland, Ohio.

*JACKSON KEMPER* is the new general manager of sales, Distributor Products Div., *WATSON-STILLMAN CO.*, Roselle, N.J. He joined the company last year as assistant to the late *A. G. YORK*, vice president.

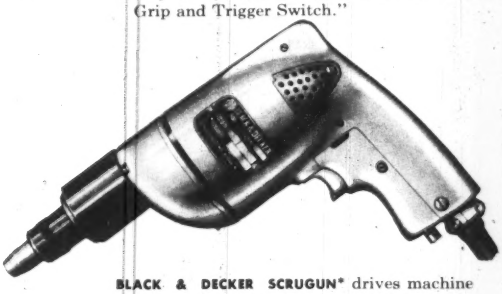
*MAX BANZHAF* has been named director of advertising and promotion for *ARMSTRONG CORK CO.*, Lancaster, Pa., to succeed *E. CAMERON HAWLEY*, who has resigned. With the company since 1938, Mr. Banzhaf has most recently been assistant director of advertising and promotion.

The new chairman of the board for *JOHN B. ASTELL & CO., INC.*, New York, is *JOHN B. ASTELL*, and *H. L. BIALOCK* has been made president. Mr. Bialock had been manager of sales for a division of National Tube Co. *FRANK J. HEINZMANN* has been appointed vice president, and *EDWARD J. MOGOL*, secretary.

# *Speed up Assembly!*

## Switch to BLACK & DECKER POWER!

**BLACK & DECKER HOLGUN*** drills holes to ¼" diam. in steel, to ½" diam. in hardwood. Perfectly balanced, light in weight, compact, easy to handle, accurate. Famous "Pistol Grip and Trigger Switch."



**BLACK & DECKER SCRUGUN*** drives machine screws and nuts to ¼", self-tapping screws to #12, wood screws to #10 x 2". Positive or adjustable clutch available. Same design features as B&D HOLGUN!

**SEE YOUR NEARBY B&D DISTRIBUTOR** for demonstrations and full details on this famous team of assembly tools. They'll help your men turn out more work, with less fatigue and less spoilage. And you have nearly 50 other B&D Drill and Screw Driver models to choose from to fit your needs on heavier work! Write for free catalog to: THE BLACK & DECKER MFG. Co., 628 Pennsylvania Ave., Towson 4, Md.

*Trade Mark Reg. U. S. Pat. Off.

SHEARS

SANDERS

BENCH GRINDERS

HAMMERS

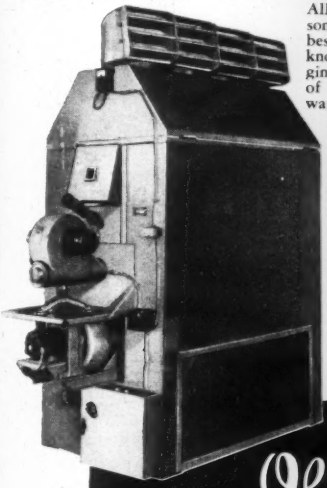
LEADING DISTRIBUTORS EVERYWHERE SELL

B&D Black & Decker PORTABLE ELECTRIC TOOLS

# LOOKING FOR SOMETHING?

Anyone looking for parts, to repair or service a heater is well off if the parts are standard products of nationally known manufacturers.

All accessories on Olson heaters are of the best name and quality known to heating engineers. Replacement of these parts are always easily available anywhere.



Olson unit or central warm air heaters are manufactured by heating engineers with the "know how" gained from many years of experience in the heating industry.

Olson

ARTHUR A. OLSON & CO.
Gas, Oil, Coal or Dual Gas and Oil
BROAD ST. · CANFIELD, OHIO

*Write for complete information and data sheet, showing horizontal and inverted models, stoker fired and duct units.*

The newly appointed advertising and promotion manager for *TRI-CLOVER MACHINE CO.*, Kenosha, is *ROBERT L. NISSEN*, formerly advertising and publicity manager of Flexonics Corp.

*HAROLD H. HATCH*, manager of the repair department, Controls Div., *PERFEX CORP.*, Milwaukee, has been named service manager. He joined the company in 1936.

*J. A. CUNEO* is now general sales manager for *FAIRBANKS, MORSE & CO.*, Chicago. He was manager of the Chicago branch. *C. E. DIETLE*, formerly Diesel Dept. manager of the branch, has been named manager, Diesel Sales Div. *GORDON R. ANDERSON*, formerly manager of the Freeport Works, has been promoted to the post of general manager, Electrical Div., which includes manufacturing and sales. In addition, *GEORGE C. WORTHLEY*, former manager, Scale Div., is now general manager of the division, and *JOE PETERSON* is now division sales manager.

*C.A. DUNHAM CO.*, Chicago, has appointed *E. W. CARDIFF* as advertising manager. He has been acting manager of the marketing and promotion department.

*CHARLES W. PRESSLER*, formerly assistant chief engineer, is the new chief engineer for *AVERY ENGINEERING CO.*, Cleveland. He succeeds *DENNIS BOGGS*, who has been named district manager for the company in Akron.

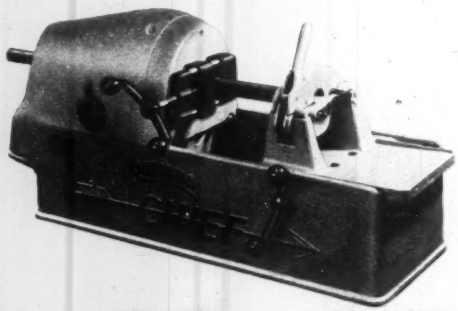
## . . . IN THE TERRITORIES

For *BALTIMORE AIRCOIL CO., INC.*, Baltimore—a number of new representatives. Covering California, Nevada, Oregon, Washington, Idaho, and Vancouver, B.C. —*RUSSELL SALES CO.*, 4216 Pacific Way, Los Angeles; for eastern half of Tennessee—*L. D. McILWAIN*, 4701 St. Elmo Ave., Chattanooga; for Nebraska and western third of Iowa—*ANDERSON BROS. ENGINEERING CO.*, 3109 Martin Ave., Omaha; for northern New York State and metropolitan Toronto and Montreal—*H. E. RIECKELMAN CO.*, 412 Jackson Bldg., Buffalo; for Minnesota and North and South Dakota—*UHL CO.*, 132 S. 10th St., Minneapolis; for Georgia and Alabama—*B. W. EMBRY*, 536 Shannon Drive, SW., Atlanta.

For *KEWANEE BOILER CORP.*, Kewanee, Ill.—new Des Moines branch territory representative, *WALTER P. PETERSON*, 101 Hubbell Bldg., Des Moines. He succeeds *GEORGE W. BOGARDUS*, retired after more than 37 years association with the company.

For *MACHINERY DIV., DRAVO CORP.*, Pittsburgh—*LOY E. RUSSELL*, new sales engineer, metropolitan New York territory.

For *THE NATIONAL RADIATOR CO.*, Johnstown, Pa. —new northeastern New Jersey sales representative for industrial, commercial and residential boilers, radiators and heating accessories, *ROBERT B. HAARDE*, formerly with the New York City branch office.

YOU CAN CUT YOUR COSTS **NOW** WITH THESE TWO **QUIJADA** TOOLS!

**QUIJADA CHIEF** PIPE AND CONDUIT THREADER

Threads, reams and cuts pipe or conduit faster than any power threader you've ever seen. 2 in. pipe COMPLETE in just 32 seconds. The only threader with completely automatic chucking. Just a pull of the switch to chuck and a push to un-chuck. Cutter on front jaw housing makes it simple to make up fittings on machine. You need not remove cutter.

It's PORTABLE TOO! Quijada Chief weighs only 160 pounds. Take it right on the job...mount it on your truck...use it in the shop. No limitations. Use anywhere there is power.

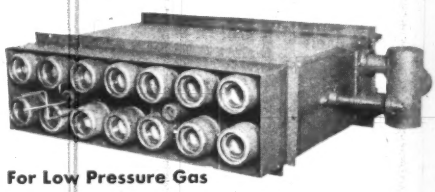
**E-Z cutter**

The only cutter with power driven rollers. Cutter always cutting, never slipping. Easily 500 cuts to a sharpening. E-Z cutter is not just a shop tool. The light weight of only 100 pounds makes a power cutter feasible anywhere there is power.

**QUIJADA TOOL CO., INC.**
5474 Alhambra Avenue
Los Angeles 32, California

SEE YOUR JOBBER OR WRITE TO DEPT. HC-2

# WEBSTER KINETIC* BURNER



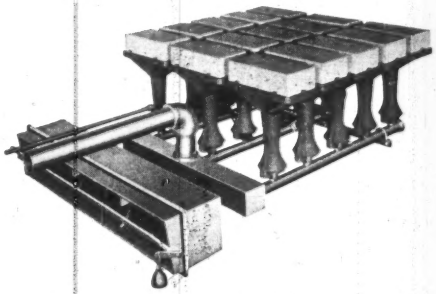
**For Low Pressure Gas**

The Webster Kinetic consists of a multiplicity of full venturi mixers with flame retention nozzles. These are assembled in a metal casing complete with pilot and louvre. It may be used with natural, mixed or liquefied petroleum gases. Standby oil burners may be used when desired. As a multiple head assembly it is available in 25 standard sizes of from 4 heads to 48 heads, and can be supplied in any size or shape. Natural gas input ratings from 560,000 Btu/hr to 6,720,000 Btu/hr at 4" wc.

For complete information request Series B8 Bulletins.

# WEBSTER SERIES F 600 BURNER

## For Low Pressure Gas



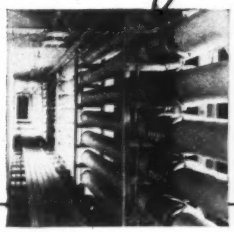
Designed for LOW GAS PRESSURE
INTERCHANGEABLE PORTS
RADIANT fire brick top
NO COMBUSTION CHAMBER required
Will NOT VIBRATE
LOW draft loss
ANY SHAPE and SIZE
INTEGRALLY MOUNTED pilots

*TRADEMARK

**The WEBSTER ENGINEERING COMPANY**
TULSA, OKLAHOMA
*Division of SURFACE COMBUSTION CORPORATION, Toledo, Ohio*

# ENGINEERED *for tomorrow*

**. . . Badger EXPANSION JOINTS . . . assure long, trouble-free life . . . an engineering masterpiece**



Leading textile plants are erecting ultra-modern buildings which are both *designed* and *engineered* for tomorrow. The structures represent the very latest trends in functional design . . . and the steam distribution systems must be engineered to perform with maximum efficiency. As you would expect, Badger Corrugated Packless Expansion Joints, constructed to the famous Directed-Flexing Self-Equalizing design, are first choice with these forward-looking companies.

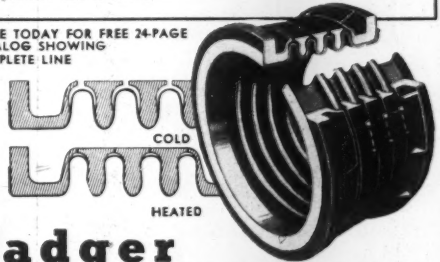
* * * * * *

What's the reason you find Badger Expansion Joints specified on *important* jobs? Because engineers have learned from years of experience to put their faith in the performance of Badger Joints . . . performance that's a result of construction features like these:

- Directed-Flexing Self-Equalizing rings . . . progressively control the movement of the all-curve corrugations.
- Packless . . . pressure-tight single tube — requires no maintenance.
- Compact . . . approximately the size of flanged fitting.
- Special forming . . . no structure-weakening stresses.
- Controlled heat treating . . . assures long life.
- Wide range of traverse — pressure — temperature.

Fabricated from deoxidized copper for normal pressures and temperatures, stainless steel or alloys to withstand high pressure, temperature and corrosion.

WRITE TODAY FOR FREE 24-PAGE CATALOG SHOWING COMPLETE LINE

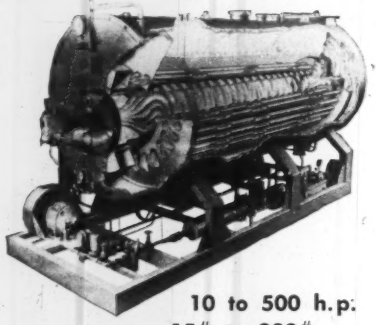



**Badger**
**MANUFACTURING COMPANY**
**230 BENT STREET, CAMBRIDGE, MASS.**

AMESTEAM GENERATOR

I BOUGHT ONE! Because It's

EASY TO INSTALL
EASY TO OPERATE
EASY TO CLEAN



10 to 500 h.p.
15# to 200# w.p.
OIL or GAS

WRITE FOR BULLETIN 1011-C

AMES IRON WORKS
BOX G-2 OSWEGO, N. Y.
Builders of Better Boilers Since 1848

For *THE YOUNGSTOWN SHEET AND TUBE CO.*, Youngstown, Ohio — *A. A. HARE*, new district sales manager, Pittsburgh, succeeding *G. B. STRAUSNER*, retired after 40 years' service.

For *CONTROLS DIV., PERFEX CORP.*, Milwaukee—*IDWAL W. PARRI*, named district manager in charge of sales and service, with headquarters in Portland, Ore. He had been controls service manager and field education director. *R. B. DUNNING*, Bangor, Me., appointed distributor of heating controls for northwestern Maine, from Waterville and Rockland north to the Canadian border.

For *UNITED STATES AIR CONDITIONING CORP.*, Minneapolis—six new direct factory dealers in the South and Southwest: *MONARCH THEATRE SUPPLY, INC.*, Memphis; *McADAMS SHEET METAL CO.*, Pascagoula, Miss.; *MANDAL'S SHEET METAL ROOFING & SIDING CO.*, Gulfport, Miss.; *GOETTL BROS. METAL PRODUCTS, INC.*, Phoenix; *NICHOLS REFRIGERATION CO.*, Nashville; and *REED TRAVIS & ORSBORN CO.*, McMinnville, Tenn.

For *AMERICAN RADIATOR & STANDARD SANITARY CORP.*, Pittsburgh—two new sales districts and six new sales offices. Managing the new east central district, headquarters in Cleveland, *J. A. HICKMAN*, formerly manager, Atlanta office. District includes the Detroit, Cleveland, Cincinnati and Pittsburgh Sales offices. Managing the new south central district, headquarters in Kansas City, *L. L. GRAVES*, former manager, Denver office. District includes Kansas City, St. Louis, Omaha, New Orleans and Dallas sales offices. The new sales offices are in New Orleans, manager, *DONALD E. SANDER*; Cleveland, *GEORGE W. PALMER*; Omaha, *ROBERT F. HENDERSON*; Long Island, N.Y., *L. R. GRAVES*; Jacksonville, Fla., *ALBERT J. ELLISON*; and Salt Lake City, *ROBERT G. HOLMES*. Other appointments include *JOHN E. HUEY*, manager, Atlanta office; *KARL H. SMITH*, manager, Denver; *FREDERICK R. DANNIES*, manager, Milwaukee; *ROSS E. BISHOP*, assistant manager, Minneapolis; and *HOWARD A. STEIGER*, assistant manager, Newark, N.J.

For *TIMKEN SILENT AUTOMATIC DIV., TIMKEN-DETROIT AXLE CO.*—three new district sales managers: *OLAF G. BEESTRUM, JR.*, for Iowa; *HILMER J. HASENOHRL*, southern Illinois, Missouri and Kansas; and *WESLEY C. ROBINSON*, for part of Ontario.

For *THE PERMUTIT CO.*, New York—*CLYDE R. POORE*, assistant sales engineer, Charlotte, N.C., office.

For *INTERNATIONAL HEATER CO.*, Utica—*CLYDE T. MOYER, JR.*, representative for Connecticut, lower New York, and northern New Jersey, handling furnaces, boilers, and conversion burners.

---

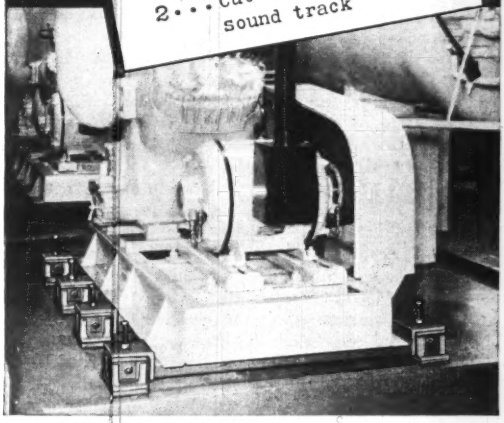
Three executives of Carrier Corp. were killed January 22 in the plane crash at Elizabeth, N.J. They were John F. Chester, 45, director of public relations, Carl U. Spriggs, 44, manager of the dealer sales division, and H. Lee Sterry, 50, executive assistant.

# Here's How

**PATHÉ**

1...Salvaged expensive "lost" office space

2...Cut rejects on film sound track



These two Worthington compressors, installed in a machinery penthouse on the 11th floor of the Pathé Television Center, New York, are now mounted on Korfund standard steel spring vibro-isolators. The structural steel saddles shown are not ordinarily required, but were used in this case so that original piping could remain unchanged.

## ...by controlling vibration

When originally installed, each of these two big compressors was mounted on 4 rubber-in-shear rails, which were not the proper isolation for the vibration frequency and floor conditions.

Consequently, vibration transmission through these "vibration eliminators" was so bad that it was impossible to use office space on the floor below, and vibration and noise transmitted through the building were picked up on film sound tracks several floors down.

Now, remounted on Engineered Korfund Spring Isolators, the job is entirely satisfactory and has been in operation for the last three years.

Korfund Engineered Vibration Control would have cost no more in the beginning.

A selector chart in Bulletin G-104 gives basic isolation recommendations for both normal and critical operating conditions for pumps, fans, compressors, refrigerating and other types of mechanical equipment. See Sweet's Catalog Files, or write us for your free copy today.

We'll gladly submit recommendations without obligation. A half century of experience is at your disposal.

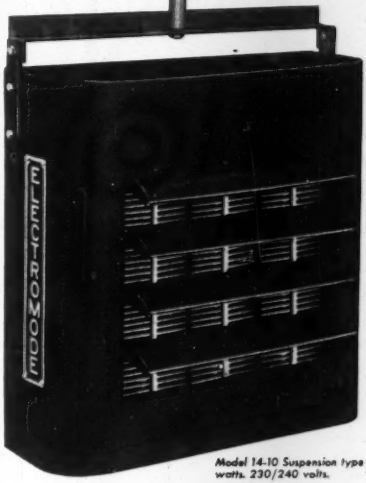
KORFUND VIBRATION CONTROL — SPRINGS — RUBBER — CORK

Representatives in Principal Cities

**THE KORFUND COMPANY, INC.**

48-01F Thirty Second Place • Long Island City 1, N. Y.

# Hard-to-heat areas? use ELECTROMODE

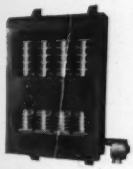



*Model 14-10 Suspension type 10,000 watts. 230/240 volts.*

**Do you have a heating problem in your plant or office . . . any hard-to-heat area? Electromode heaters are your logical answer.**

**Here's why . . . Electromode heaters are available in all sizes and capacities from 1500 to 45,000 watts to fit any heating problem. They can be located anywhere that electrical wiring can be strung. Equipped with automatic temperature controls and built-in safety switch, means economy of operation and absolute safety from fire, shock, or burn. The exclusive patented cast-aluminum heating elements will not rust or corrode. Electromodes provide an abundance of fan-circulated heat when and where it is needed. Approved by Underwriters' Laboratories and thousands of commercial and industrial plants throughout the country.**

## EXPLOSION-PROOF HEATERS for HAZARDOUS LOCATIONS



The only Electric Explosion-Proof Heater of its kind approved by Underwriters' Laboratories. Features Electromode patented cast-aluminum heating element. Specially designed for installation in hazardous areas where heat is required and danger of explosion exists. Available in 2000, 4000, 6000 watt capacities. For full particulars mail coupon below.

*Model CX-2 Convection type 2000 watts 240/480 volts.*

ELECTROMODE All Electric HEATERS

**ELECTROMODE CORPORATION**
**Dept. HP-22, 45 CROUCH STREET**
**ROCHESTER 3, N. Y.**

Consult your electrical wholesaler or contractor for complete Electromode Heater information.

*We are interested in*
- ☐ Electromode Industrial Heaters
- ☐ Electromode Office Heaters
- ☐ Electromode Explosion-Proof Heaters

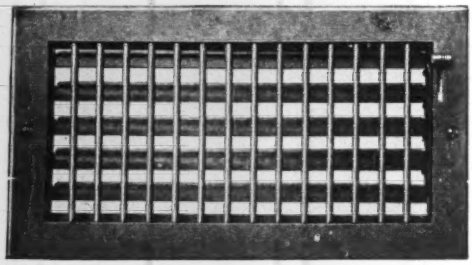
NAME _____

TITLE _____

ADDRESS _____

AUER "Streamliner"

Multiple Deflection Air Conditioning
REGISTERS and GRILLES
for High Velocity Outlets



No. 1005V-HML. Single bank of adjustable bars, multi-louvre valve.

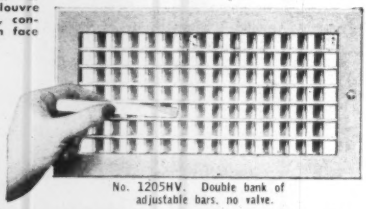
**For top efficiency in modern air conditioning, ventilating, and cooling systems — get Auer Streamliners. In these registers and grilles, the bars are beveled, carefully formed, smooth in contour. Each bar is pivoted in frame on special split sleeves, or "expansion" inserts, furnishing proper tension to hold bar firmly in position (and maintain silence when register is in operation at high velocity) yet readily adjustable to any desired angle.**

**Bars have "tear-drop" shape in cross-section, somewhat like an airplane wing, and being pivoted at the exact center, may be completely reversed. This permits you to turn the *thin* edge outward, if you wish (and the *broader* edge toward air-flow) cutting resistance and turbulence to the minimum. Bars may be set in any grouping, and repeated adjustments will not affect their rigidity when set. Shutters of multi-louvre control valves are pivoted on rivets to prevent any vibration. All Streamliner registers equipped with gaskets. Write for Folder S-50 with sizes and prices.**

8 MODELS

The Series includes models with single bank of adjustable bars (vertical or horizontal), also with double bank of adjustable bars (vertical in front and horizontal in back, or the reverse), also all above four types with the addition of horizontal multi-louvre valves in the rear, controlled by lever on face of register.

Complete Auer Register Book — or Catalog on perforated grilles — sent on request.



No. 1205HV. Double bank of adjustable bars, no valve.

The Auer Register Co., 6600 Clement Ave., Cleveland 5, Ohio

Auer REGISTERS
& GRILLES for AIR CONDITIONING & GRAVITY

# NEW BOOKS & REPORTS

## Volume on Design and Operation of Heating Systems

The usual reference book on heating provides coverage of the design and operation of steam, hot water, warm air and radiant heating systems together with information on such auxiliaries as fans, heaters, boilers, burners, stokers and similar components. In this respect, *Heating Design and Practice*, by Robert Henderson Emerick, is somewhat unusual, since it also provides chapters on incinerators and destructors, chimney stacks and flues, and fireplace design and performance, and gives specifications on the analysis of beds. Mr. Emerick is a consulting mechanical engineer, and his new book presents information which will be of value to architects, engineers and contractors and all those concerned with practical heating design and installation problems.

The book, however, does not provide a precise treatment such as that required by students, teachers, research workers, and others concerned with the more technical aspects of heating analysis. For example, enthalpy is defined as a term used to express heat content or total heat; percentage relative humidity is loosely construed to be the percentage saturation; and specific heat is defined as the amount of heat which will change the temperature of a pound of a material one degree F. no further restrictions being outlined as to the conditions surrounding that change. In addition, in his discussion of temperature, the author notes that "Nowadays, we suppose the absolute zero to be approximately 460 degrees lower than Fahrenheit's conception of the term, but there is reason to suspect we shall be obliged to lower this conviction also, and before too long."

In addition to the contents indicated earlier, chapters are included on terms and definitions; how heating loads are calculated; designing of steam heating systems; heating boilers and steam generators; designing a hot water heating system; boiler firing equipment; water heaters and how to size them; designing of warm air heating systems; panels, baseboards and unit heaters; fans and filters; space heaters, domestic and industrial; district steam heating; the heat pump; combustion; heat insulation and refractories; and how to choose a heating system. This 453 page book is unusually well illustrated with 222 modern photographs and drawings and also contains 130 tables of reference material. A satisfactory index with eleven pages of references and cross references is provided. The book is available from the publisher, McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 18, at $8.00 a copy.

RICHARD C. JORDAN

## Commercial Standards for Ventilating and Attic Fans

*Commercial Standard CS 178-51* covers construction requirements and methods of testing and rating for axial and propeller fans (industrial and residential use). Marking requirements (motor ratings, compliance labeling, etc.) also are outlined.

*Commercial Standard CS 179-51* treats the installation of attic fans.

IN STOCK for Your Convenience

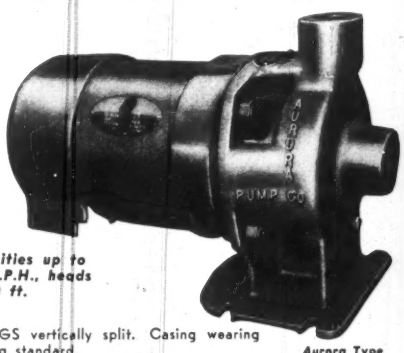
# AURORA CLOSE-COUPLED *Package* AIR CONDITIONING PUMPS

*They have EVERYTHING!*

- ☑ LOW COST
- ☑ LONG LIVED
- ☑ SMOOTH, QUIET
- ☑ MECHANICAL SEAL
- ☑ DEPENDABLE
- ☑ DISASSEMBLY is QUICK and SIMPLE*

*for*
**EVAPORATOR COOLING TOWERS**
•
**AIR CONDITIONING UNITS**
•
*also for*
**GENERAL SERVICE**

Air conditioning contractors as well as manufacturers of air conditioning equipment will welcome these notable close-coupled package pumps. Mechanical seal requires no packing or maintenance. *Pump may be disassembled without disturbing discharge connections or hold down bolts. Sturdy, lasting and efficient.



***Capacities up to 150 G.P.H., heads to 100 ft.***

*Aurora Type JMC Pump — Close-Coupled*

CASINGS vertically split. Casing wearing ring standard.

MECHANICAL SEAL is standard on all sizes and located in packing cover.

IMPELLER is balanced, of enclosed type, high grade bronze.

MOTOR — NEMA specifications, Stainless Steel Shaft on JMC — for all circuits and various enclosures.

BALL BEARINGS — on JMC built into motor.

**OTHER AURORA AIR CONDITIONING UNITS**

We are also in a position to supply various sizes of air conditioning pumps in V-Belt drive, and flexible coupling drive. Our large type G.M.C. Close-Coupled Pumps can be furnished up to 800 G.P.M. and heads to 200 ft.

***Complete Information on Request***

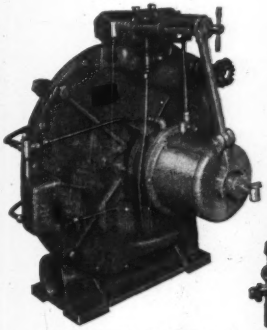
**DISTRIBUTORS IN PRINCIPAL CITIES**

AURORA Always PUMPS

**AURORA PUMP COMPANY**

80 Loucks St., Aurora, Illinois

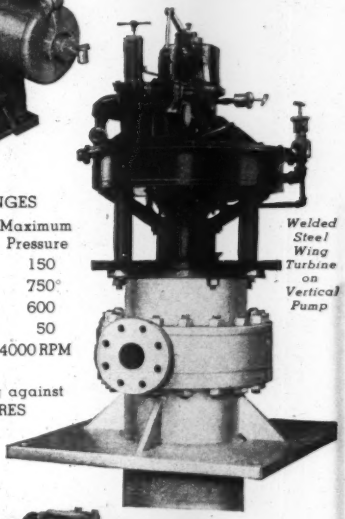




# WING AUXILIARY TURBINES

OPERATING RANGES

| | Standard | Maximum Pressure |
|---|---|---|
| Horsepowers | 100 | 150 |
| Temperatures | 525° | 750° |
| Pressures | 275 | 600 |
| Back Pressures | 50 | 50 |
| Speeds | 4000 RPM | 4000 RPM |



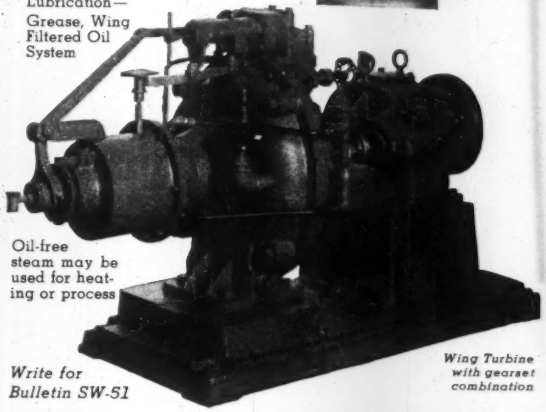
*Welded Steel Wing Turbine on Vertical Pump*

Capable of exhausting against HIGH BACK PRESSURES

Shafts—Horizontal or vertical

Rotation—Clockwise or counter-clockwise

Lubrication—Grease, Wing Filtered Oil System



Oil-free steam may be used for heating or process

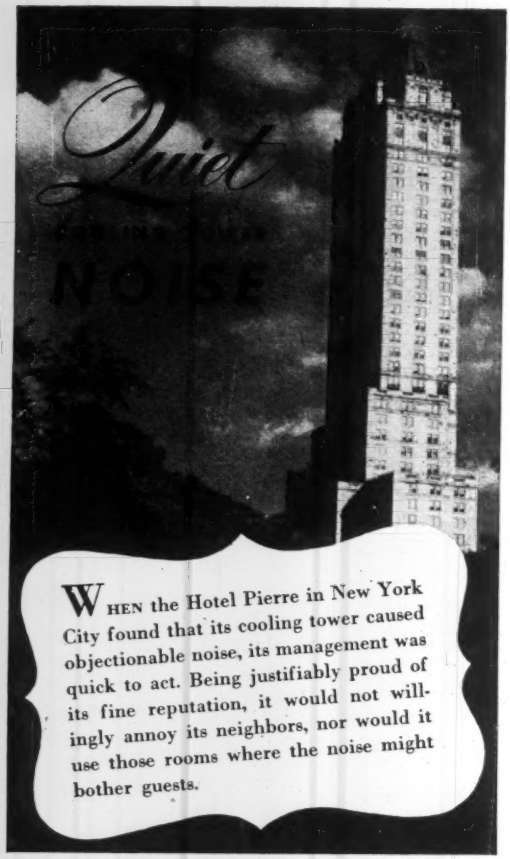
*Write for Bulletin SW-51*

*Wing Turbine with gearset combination*

**L. J. Wing Mfg. Co.** 140 Vreeland Mills Rd. Linden, New Jersey

*Factories:* Linden, N. J., Montreal, Canada

Wing **AUXILIARY STEAM TURBINES**




WHEN the Hotel Pierre in New York City found that its cooling tower caused objectionable noise, its management was quick to act. Being justifiably proud of its fine reputation, it would not willingly annoy its neighbors, nor would it use those rooms where the noise might bother guests.

**INDUSTRIAL SOUND CONTROL, INC.** measured the sound level and determined just what sound insulation was needed, and where, and quickly and effectively quieted the noise—to the entire satisfaction of the Pierre, its guests, and its neighbors.

Don't risk your precious public relations because of cooling tower noise. Call on ISC, pioneers since 1937 in cutting BIG NOISES down to WHISPERS. The methods which ISC uses to quiet test cells of the newest and most powerful jet engines, can also solve your noise problems.

**(INDUSTRIAL SOUND CONTROL, INC.** were the originators of industrial sound proofing, and their installations are job-proven over the years.)

*Write* **ISC** *today!*

*Mid-Western distributor:* Midwest Industrial Sound Control, Inc.
1455 North Pennsylvania Street, Indianapolis 2, Indiana

Industrial Sound Control, Inc.
45 GRANBY STREET HARTFORD, CONN.
2119 SEPULVEDA BLVD. LOS ANGELES, CALIF.

These are voluntary standards, intended as guides for buying, selling and specifying the products covered. They were proposed by the Propeller Fan Manufacturers' Association, and established with the Commodity Standards Div., U.S. Dept. of Commerce (in cooperation with the U.S. Bureau of Standards) serving as an impartial fact finding agency.

Copies of these standards may be obtained, at 5 cents each, from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

### Physiological and Nutritional Effects of Climatic Stress Conditions

*Nutrition and Climatic Stress, With Particular Reference to Man*, discusses how climatic factors disturb the heat economy of the body, modify nutrient requirements, improve or depress tolerance to heat, cold and high altitude, and disturb endocrine functions. The authors are H. H. Mitchell, professor of animal nutrition, and Marjorie Edman, instructor in animal nutrition, both of the University of Illinois. This 234 page book is available from the publisher, Charles C. Thomas, 301-327 East Lawrence Ave., Springfield, Ill., at $6.75 a copy. It will be reviewed fully in a later issue.

### Books Comprise Papers on Various Phases of Building Research

Books containing the papers presented in the three divisions of the Building Research Congress, 1951, England, are now available. The *Division 1* book contains papers on building techniques, structural matters and soil mechanics; *Division 2* offers papers on building materials; and *Division 3* papers deal with acoustics, heating and ventilating, etc., and with problems of hospitals, factories and schools. The record of the discussion which took place at the technical sessions may be ordered now, in advance of publication.

The books may be ordered from the organizing secretary of the congress, Building Research Station, Garston, Watford, Herts, England. Single copies are $3.15, and the set of three is $7.00. Members of the participating bodies of the congress may obtain single books at $2.45 each. The record is available at $3.50 ($2.80 to Congress members).

### OTHER BOOKS AND REPORTS RECEIVED

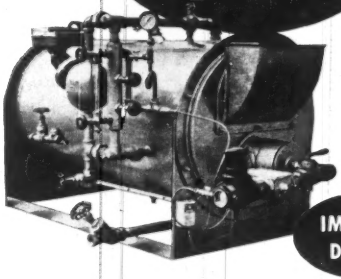
In *ESSENTIALS IN PROBLEM SOLVING*, the author, Zuce Kogan, discusses general methods for solving problems in terms of his experiences as a consulting engineer. The first step, he points out, is to generalize the problem — find its similarities to other kinds of problems — and then match it with a general solution. The general approach thus arrived at can be used to direct thinking towards a specific solution. (He illustrates this method by referring to a boiler efficiency problem which "seemed to resolve itself into the impossible job of making a damper that would leak and not leak at the same time"). Also treated are the personal factors influencing the selection of the approach, for example, the different ways in which a chemist, a metallurgist, and a physicist approach the same problem. The author outlines the "processing" of the problem, which is solved by choosing from a series of alternatives which follow one another in sequence.

The 79 page paper bound book is available from the author at 724 Sheridan Rd., Chicago 13.

# A NEW KIND OF COMPACT STEAM POWER

NEVER BEFORE has such amazing *power* been built into such a *compact, efficient* boiler unit! The magic midget Scotch-mund is "power-packed" to deliver faster steam at constant pressure. It's a new, exciting experience for industrial users of steam power. Small, compact... fits almost anywhere. Easily and quickly installed. Either gas or oil fired. A.S.M.E. approved and fully *guaranteed* by MUND... the most dependable name in modern boilers.

**scotch-mund**
(3 to 30 H.P.)



*the magic midget steam boiler*

**IMMEDIATE DELIVERY**

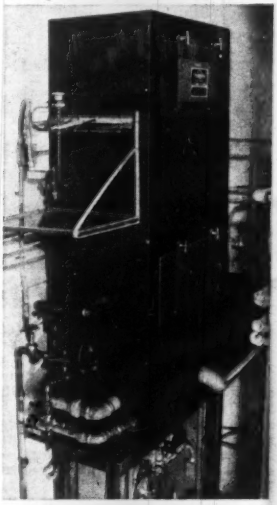
Write for complete details

*...More power and larger capacities (5-350 H.P.) with* **MUND** *inclined water tube boilers.*

**MUND BOILERS, INC.**
1600 N. Indiana St., Los Angeles 63, Calif.

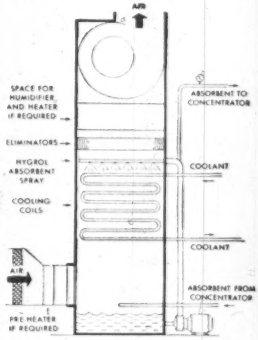
# New "Controlled Humidity" Method Gives a Better Solution to Air Conditioning Problems

***"Hygrol"***
***Absorbent***
***Liquid***
***Dehumidifies***
***Fresh Air***
***Without***
***Refrigeration***



● NIAGARA Air Conditioners or Dehumidifiers using "Hygrol" liquid absorbent give precise control of air temperature and humidity . . . at lower operating cost, with large savings in space and with smaller and less expensive equipment, in many applications.

This method dehumidifies the air by passing it through a chamber in which "Hygrol" spray removes its moisture and produces a low dew point. The "Hygrol" solution resulting is continuously and automatically re-concentrated, providing always full capacity in air conditioning and assuring always a constant dehumidifying capacity and a trustworthy, constant condition for your material, apparatus, process or room to be conditioned.



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

"Hygrol" is a liquid, not a salt solution; it stays pure and non-corrosive; does not cause maintenance or operating troubles in food plants or in chemical processes.

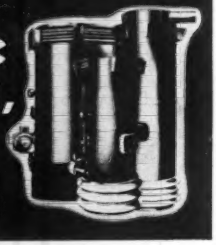
Investigate this new Method for "comfort" air conditioning as well as to protect quality in hygroscopic material, or processes or instruments, or to prevent condensation damage to metals, parts or products.

*Write for Bulletin No. 112*

**NIAGARA BLOWER COMPANY**
*Over 35 Years of Service in Industrial Air Engineering*
*Experienced District Engineers in Principal Cities of U.S. & Canada*
Dept. HP, 405 Lexington Ave. New York 17, N.Y.

a new idea in economical heating for industry

THERMOBLOC self-contained, direct-fired units

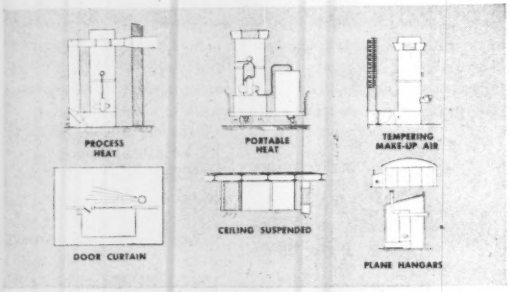


*Efficient, controlled, low-cost heat!*

Here's the answer to thousands of heating needs—the revolutionary new THERMOBLOC. Direct circulating heat from individual units keeps heated air moving in and around working areas. Has rugged, boiler-type construction. Easy to install, operates immediately on oil or gas. No complex piping, duct work or radiators. Units come complete or ready for simple assembly and prompt installation.

Installation costs as low as one-third, operating costs down to one-half of other types or methods. Perfect for large industrial plants, foundries, machine shops, bus terminals, warehouses and small or large commercial buildings, such as retail stores, skating rinks, gas stations, etc. Single units or combinations of any of the five sizes will meet any heating requirement.

Send for the data book. Contains tables and engineering data on heating constants, building materials, etc. Our engineers will help you on any heating problem. Mail the coupon today.




THERMOBLOC DIVISION
PRAT-DANIEL CORPORATION
5-2 MEADOW STREET S. NORWALK, CONNECTICUT
Manufacturers of P-D Power Equipment

Gentlemen:

Please send me the THERMOBLOC Data Book.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

# MEETINGS & CONVENTIONS

*IBR SCHOOL OF MODERN HEATING*—February 13 to 15, Hotel Buffalo, Buffalo; February 18 to 20, Cleveland Engineering Society, Cleveland; February 26 to 28, Chicago; March 4 to 6, Milwaukee. Sponsored by The Institute of Boiler and Radiator Manufacturers, 60 E. 42nd St., New York 17. The school is a three day course providing instruction in the design and installation of hot water and steam heating systems. A complete list of meetings scheduled through June is available from the institute.

*FOURTH ANNUAL AIR CONDITIONING CONFERENCE*—February 14 and 15, Engineering and Industrial Experiment Station, College of Engineering, University of Florida, Gainsville.

*SHORT COURSE ON INDUSTRIAL VENTILATION*—February 25 to 28, Michigan State College, East Lansing. Sponsored jointly by the college's School of Engineering and the Division of Industrial Health, Michigan Department of Health, Old Dewitt Rd., Lansing 4. It is being offered for plant engineers, contractors, consulting engineers and others concerned with the design of industrial exhaust systems. General sessions will be followed by small group discussions. The technical papers to be presented are:

*How Modern Manufacturing Affects Industrial Ventilation*, by John C. Soet, Michigan Dept. of Health
*Control Must be Engineered*, by P. S. Hewitt, Reichold Chemicals, Inc.
*Principles of Hood Design* (a demonstration), by K. E. Robinson, consulting ventilation supervisor, and R. S. McClintock, Michigan Dept. of Health
*Evaluation of Exhaust systems* (a demonstration), by George M. Hama, Detroit Dept. of Health
*Piping Design*, by C. H. Pesterfield, Michigan State College
*Fans — Their Uses and Limitations*, by Richard D. Madison, Buffalo Forge Co.
*Description, Application and Efficiencies of Collectors*, by John M. Kane, American Air Filter Co., Inc.
*Air Supply — Its Importance and Economy*, by Lorin G. Miller, Michigan State College
*Value of a Good System and Necessity for Proper Maintenance*, by William G. Ferrell, Auto Specialties

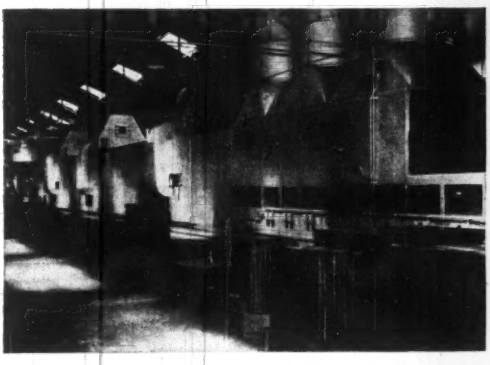
*NATIONAL ASSOCIATION OF CORROSION ENGINEERS*, 919 Milam Bldg., Houston, Tex.—1952 annual conference, March 10 to 14, Galveston.

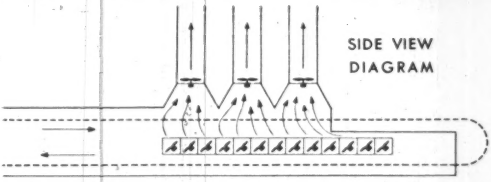
*CHICAGO INTERNATIONAL TRADE FAIR*—March 22 to April 6, Navy Pier, Chicago. For further information contact Chicago International Trade Fair, Inc., Merchandise Mart, Chicago 54.

*FIRST ANNUAL AMERICAN POWER CONFERENCE*—March 26 to 28, Hotel Sherman, Chicago. Sponsored by the Illinois Institute of Technology, Technology Center, Chicago 16. Formerly called the Midwest Power Conference, it has been renamed since the previous 13 meetings proved to be wider in scope and character than the name implied. The same group of schools and societies will participate, with the addition of The Edison Association of Illuminating Companies, and the Edison Electric Institute.

*OIL-HEAT INSTITUTE OF AMERICA, INC.*, 6 E. 39th St., New York 16—29th anniversary exhibition of

# How RHEEM cools off 500° lithographed metal in 5 minutes






## Propellair fans do an effective job

Rheem Manufacturing Co. has one of the world's largest units for drying lithographed metal at their New Orleans Plant. The equipment, developed by Wagner Litho Machinery Division, roller coats, bakes and cools metal for 55-gallon drums—all in one continuous operation.

The problem of cooling the metal from 500° to room temperature and exhausting heat and fumes was solved by the installation of Propellair Fans (direct connected type). As shown in the drawing above, twenty-six 1 HP, 30-inch fans provide high velocity air movement over the coated metal . . . blowing heat and fumes into a tunnel. Here three 60" fans (each 15 HP, 79,000 CFM) with glass-insulated motors take over, exhausting heat and fumes high over the roof. Rheem reports this ventilating system does a most effective job, economically.

## What's your ventilating problem?

For over 20 years Propellair has been solving tough air moving problems for leading companies. Propellair Fans are economical—in initial cost, in operating expense, in maintenance. Above all, they are rugged and dependable. Features include cast aluminum airfoil propellers, curved airfoil entrance rings, R & M motors, certified air deliveries.

Tell us your ventilating problem and our engineers will give you their recommendations, without obligation.

***Write for Bulletin H-3238***

**PROPELLAIR®**
DIVISION OF ROBBINS & MYERS, INC.
SPRINGFIELD · OHIO

# Insist on the Genuine! RIC-WIL

## SECTIONAL TILE AND CAST IRON CONDUIT SYSTEMS

Since 1910, Ric-wil has been furnishing Sectional Conduit Systems for low cost, efficient protection of underground insulated pipe lines.

1 **Entire system** designed by expert engineers of long experience to meet every requirement for unusual tightness, permanent alignment and long life.

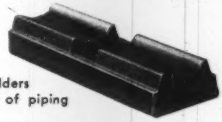
2 **Pipe Supports** designed for strength to carry the piping load.

3 **Insulation** furnished as specified or as recommended by Ric-wil's outstanding staff of engineers.

4 **Delivery:** Any size or quantity promptly from large stocks.

***CHECK THE FOLLOWING EXCLUSIVE FEATURES:***

ONLY RIC-WIL has Loc-liP joint running along entire length of conduit, including bells—assuring a completely sealed, watertight joint.



ONLY RIC-WIL design has base drain with side shoulders which carry entire weight of piping independent of conduit.

## THERE IS A RIC-WIL SECTIONAL SYSTEM FOR EVERY GROUND CONDITION:

**STANDARD TILE CONDUIT**—for normal ground loads.

**SUPER-TILE CONDUIT**—with extra heavy walls, under roadways.

**CAST IRON CONDUIT**—for installation under or near railroad tracks.

**UNIVERSAL TILE CONDUIT**—with half tile arch, trapezoidal side blocks, and concrete foundation.

Don't make the mistake of accepting inferior, poorly-designed and rank imitations of the original Ric-wil Sectional Systems. Make sure you specify "RIC-WIL"—preproved by thousands of installations—and know that you are getting the BEST.

**Write for Latest Catalog Section 480-4A.**

# RIC-WIL
## INSULATED PIPING SYSTEMS
UNDERGROUND OR OVERHEAD

THE RIC-WIL COMPANY · CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES
LEADERS IN INSULATED PIPING PROTECTION

PREFABRICATED INSULATED PIPING

SECTIONAL CONDUIT SYSTEMS

PREFABRICATED MANHOLES

UTILIDOR TYPE CONDUITS

the automatic oil-heat industry, April 14 to 18, Commercial Museum, Philadelphia. To be held concurrently with the annual convention, which will be headquartered at the Benjamin Franklin Hotel.

*NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS*, 1941 Grand Central Terminal, New York 17—Annual convention and exposition, May 1 to 3, Hotel New Yorker. For information on exhibition space available, write A. A. Lorie, Frederic R. Harris, Inc., 27 William St., New York 5.

*1952 INTERNATIONAL FOUNDRY CONGRESS AND SHOW*—May 1 to 7, Convention Hall, Atlantic City. Host this year, the American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5. The congresses are scheduled by the International Committee of Foundry Technical Associations, representing 12 countries. There will be a session on safety and hygiene and air pollution (non-ferrous), 4:00 p.m., May 3; on safety and hygiene, 10:00 a.m., May 5; and on safety and hygiene and air pollution (ferrous), 2:00 p.m., May 5.

*INTERNATIONAL CHURCHMAN'S EXPOSITION*—May 19 to 24, Chicago International Amphitheatre. Exposition managers, M. W. Hinson and J. Vancil, 19 S. LaSalle St., Chicago 3. Purpose of exposition, to aid in the planning, construction, maintenance and more effective use of church property.

*AMERICAN SOCIETY FOR TESTING MATERIALS*, 1916 Race St., Philadelphia 3—50th anniversary meeting, June 23 to 27, Hotels Statler and New Yorker, New York.

*AMERICAN SOCIETY OF REFRIGERATING ENGINEERS*, 40 W. 40th St., New York 18—Next meeting, June, Biltmore Hotel, Atlanta. Winter meeting, December, Hotel Commodore, New York City.

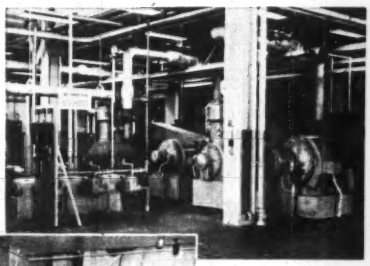
*INSTRUMENT SOCIETY OF AMERICA*, 921 Ridge Ave., Pittsburgh 12. National Instrument Conference and Exhibit, September 8 to 12, Cleveland.

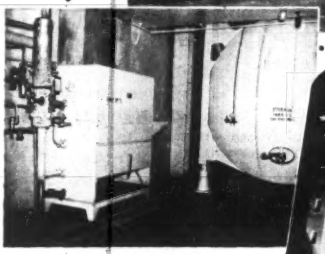
---

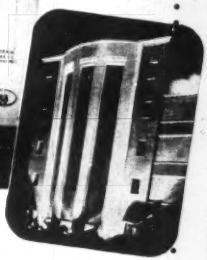
*THE DEVELOPMENT OF PROTOTYPE MODEL RESEARCH ON ATMOSPHERE POLLUTION PROBLEMS*, a four page folder, discusses and illustrates the contributions of wind tunnel model research to the solution of pollution problems, and gives an example of the effect of building configuration on stack gas dispersion. There is also an analysis of wind tunnel requirements for simulating certain meteorological phenomena affecting pollution. The material was prepared by associate professors Gordon H. Strom and William T. Ingram, New York University.

Copies, at 10 cents each, are available from Bureau of Public Information, New York University College of Engineering, New York 53.

Get the COMBI-MATIC
for Automatic Sales
• The NEW G-3A Burner (illustrated here) is versatile in application and can be used for a multitude of installations as a straight gas burner or a combination gas and oil burner. The "COMBI-MATIC" will switch from gas to oil, either from a pre-determined setting of an outside thermostat or by manual control providing an uninterrupted fuel supply.
Siemon
Combi-Matic
BURNER
COMBINES OIL AND GAS
TRADE MARK REG U S PAT OFF
ECONOMICAL • DEPENDABLE • COMPLETELY Automatic Heat
Write for Literature
SIEMON and CO.
1819 HOLMES • KANSAS CITY, MO.







at Michigan's modern

FRANKENMUTH BREWING COMPANY...

# It's VILTER Again—

● Deriving its slogan, "Genial Host," from the translation of its name, the Frankenmuth Brewing Company is the pride of friendly old Frankenmuth, Michigan. As early as 1840, a group of pioneers settled there because of the pure, sparkling spring water. Interestingly, these springs still supply the water from which Frankenmuth products—beer, bock, and ale—are brewed.

Naturally, when Frankenmuth began their extensive remodeling and re-building program, Vilter refrigeration was slated for an important part. Vilter compressors, condensers, air units, super capacity water coolers, liquid receivers, and other equipment contribute to the modern efficiency of this model brewery.

It's no surprise to see Vilter selected time and time again as America's alert breweries expand and modernize. Over half of the breweries in the country know Vilter quality and Vilter economy from their own experience. They know that Vilter equipment lasts longer, runs at lower cost, requires less maintenance, so it's only natural that many a brewery has re-ordered Vilter for over 50 years.

Vilter

Your nearby Vilter Distributor or Representative will be glad to show you how you can save with Vilter. Vilter knows brewing.

REFRIGERATION and AIR CONDITIONING

**THE VILTER MANUFACTURING COMPANY**
**MILWAUKEE 7, WISCONSIN**

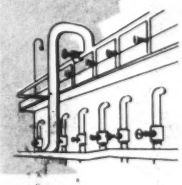
Ammonia and Freon Compressors • Pakicers • Evaporative and Shell & Tube Condensers • Pipe Coils • Valves and Fittings • Air Conditioning

# NERVA-PLAST®

## COLD SETTING CEMENT

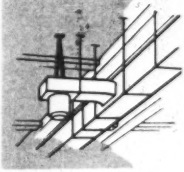
a completely waterproof, weatherproof, corrosion-resistant, flexible, applied coating

**KEEPS INSULATION INTACT**



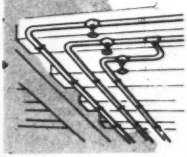
Prevents deterioration of porous heat insulating materials and pipe covering on outside lines and equipment above and below ground.

**PROTECTS DUCTS AGAINST INSIDE CORROSION**



When applied directly to inside of ducts, Nerva-Plast forms a protective coating against condensation, corrosive gases and moisture.

**PREVENTS CONDENSATION**



. . . where applied directly on cold water lines in textile and other industrial plants requiring a high degree of humidification.

Resists effectively the deleterious action of acids, alkalies, Portland cement, and sub-zero temperatures

●

Bonds readily and efficiently to all types of heat insulation materials, metals, asphalted felts and concrete

●

Nerva-Plast is easily and economically applied. Can be brushed, sprayed or trowelled on. Will take aluminum paint easily.

Mail coupon for additional information

SEE OUR CATALOG IN SWEET'S

RUBBER & PLASTICS COMPOUND CO., INC. 30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

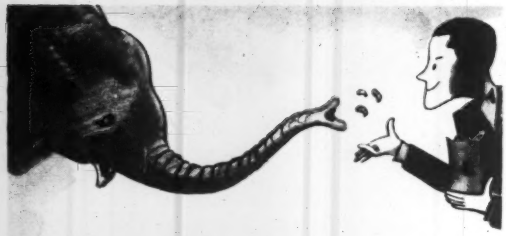
Please send me information on Nerva-Plast for use on .....

Name.....

Company.....

Street.....

City.....Zone.....State.....



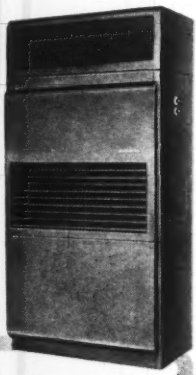
**PEANUTS ARE GREAT FOR ELEPHANTS**

**but Air Conditioning Dealers thrive on Profits**

★★★★★

*says*

**TYPHOON**



No wringing of hands or crying in their beer by Typhoon dealers. They make money on air conditioning—year in, year out. For Typhoon's policy is: "every dealer must prosper." And Typhoon makes good on this policy with a brass tacks program that brings in more dollars for dealers.

**TYPHOON 5-Way PROFITS PLAN**

1. Typhoon, America's No. 1 specialist in packaged air conditioners, brings you the most complete line of units in the quick-profit range — 1½-2-3-5-7½-8-10-15 and 20-tons. There's a size for every job!
2. Typhoon units are engineered to deliver full rated capacity even after years of hard service. This means minimum servicing, maximum profits and good will.
3. Typhoon delivers air conditioning at the lowest dollar cost per ton capacity—value that means full markup for you.
4. Typhoon district managers give you 100% sales cooperation, with practical in-the-field training for your sales force.
5. Typhoon units are backed by 42 years of experience in the air cooling field . . . and by an advertising and promotion program that produces a steady flow of leads for you.

*Want to know about the finest dealer setup in the business? Write us today.*

**TYPHOON AIR CONDITIONING CO., INC.**

794 UNION STREET, BROOKLYN 15, NEW YORK


# RECENT TRADE LITERATURE

*For your convenience in obtaining copies of these bulletins, see coupon on page 179. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.*

### Adjustable Port Valves

HPAC 101—Catalog 1800 (12 pages) covers the combined use of "Air-O-Motor" diaphragm operators and the adjustable port valves of North American Mfg. Co., Cleveland — Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 40, Wayne and Windrim Aves., Philadelphia 44. Complete specification data is given on valves for gas, air, oil, steam and water regulation. Also included are mounting dimensions, material specifications, and maximum pressures.

### Air Conditioning Cabinets

HPAC 102—Bulletin 3703A describes Model G air conditioning cabinets, both horizontal and vertical models, in sizes of from 875 to 22,000 cfm — Buffalo Forge Co., 171 Mortimer St., Buffalo 5. Combinations are available for various conditioning functions, such as cooling, dehumidifying and cooling, heating and humidifying, and continuous air cleaning. The booklet describes recent changes designed to afford more flexibility, simplified installation and easier maintenance. All parts are standardized; construction is sectionalized; and wheel shafts, hollow and oversize, are intended to develop high static pressures without vibration. The new vertical type cabinets are more compact, utilizing flat type filters. Included in the bulletin are capacity tables, diagrams, charts and detail photos.

### Air Conditioning, Heating Estimating Guide

HPAC 103—Estimating guide (24 pages) for refrigeration, ventilation, heating, and air conditioning contractors, contains information on fans, pumps, motors, condensers, accessories, etc. — M. Blazer & Son, P. O. Box 26, Passaic, N.J. Sizes, net prices, capacities, and other relevant data are given.

### Anti-Rust Paint

HPAC 104—Bulletin 136-11 describes "Rust-Cure" paint, designed to seal rusted surfaces and retard further rusting action — The Monroe Co., Inc., 10703 Quebec Ave., Cleveland 6.

### Automatic Regulating Valves

HPAC 105—Bulletin 700 covers pilot operated regulating valves, describing their special features — Spence Engineering Co., Inc., 32 Grant St., Walden, N.Y. Two types of pressure regulator, a pump governor and a temperature regulator are shown, and there is an explanation of how the control functions of the regulators can be changed by using a different sensitive pilot.

*and naturally they're using

## STANDARD'S NEW

# Perimeter Floor Register

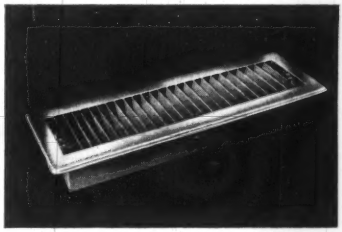
*with Standard's exclusive*
*DIALAMATIC CONTROL*

*This is it!

**Model No. PH-142**

**Works Better**

**Made Stronger**



**SPECIFICATIONS**

The face and blades of model PH-142 are fabricated of 16 gauge steel, the blades are set in a fixed-fan angle degree for even deflection. The frame is of one piece, 18 gauge steel construction. The Louvre box fabricated of 16 gauge steel. Packed one to a box, and 20 to a master carton. Comes handsomely finished in gleaming, durable metallic-lustre.

*For more information and Standard's New Pocket Catalog, attach this coupon to your business letterhead and mail to:*

## Standard Stamping & Perforating Co.

3151 WEST 49TH PLACE · CHICAGO 32, ILL.

---

# TWO MORE STANDARDS *in Modern* VENTILATION by PENN

Liberty® VENTILATOR

**LIBERTY VENTILATOR** . . . a reliable standard for modern ventilation. All the air currents—upward, downward, horizontal or swirling—are converted into powerful suction forces by ingenious arrangement of baffles & wind vanes. Capacity Ratings, based on all-angle wind tests*, prove the Liberty free from backdrafts!

*United States Testing Co., Inc. Test #E-1532-9-11-50

Penn DYNAFAN®

**DYNAFAN** . . . engineered for quiet air removal where static pressure and other special conditions are encountered.

- Motors out of air stream!
- Units are low—blends well with modern architectural design!
- Operating parts easily accessible!
- Statically and dynamically balanced non-overloading fan!

*Write for complete literature today!*
*Representatives and Distributors In Principal Cities*

FOR MORE THAN 25 YEARS THE BUILDERS' ROOF TOP LINE

**PENN VENTILATOR CO.**
PHILADELPHIA 40, PA.

**Kno-Draft recommends**
***Alnor* VELOMETER**
**for Precision Air Flow Readings**

**Ask The W. B. Connor Engineering Corporation how to balance an installation equipped with their Kno-Draft diffusers, and they'll tell you . . . measure the *actual* air delivery—precisely and quickly—with an Alnor Velometer.**

**Balancing a Kno-Draft equipped installation is a fast and accurate process when using an Alnor Velometer. A few simple readings of the instrument and a twist of the wrist are all that is required to adjust the air flow to the desired amount.**

**The Velometer is the *only* instantaneous, direct-reading air velocity meter—accurate in all ranges, from high to low—compact, portable, easy to understand and use. Wide assortment of jets and fittings makes this precision instrument ideally suited for all air velocity measurement.**

**For your air measurement needs, get an Alnor Velometer. You'll save time and money wasted in balancing air distribution on your next installation. If you'd like a copy of the instructions on balancing Kno-Draft diffusers with the Alnor Velometer, just send the coupon below.**

Illinois Testing Laboratories
Room 513, 420 N. LaSalle St.
Chicago 10, Ill.
☐ Send Kno-Draft Balancing instructions
☐ Send Velometer Bulletin 2448-G

Name.....
Company.....
Address.....
City.....Zone.....State.....

*Alnor* PRECISION INSTRUMENTS FOR EVERY INDUSTRY

### Automatic Safety Pilots

HPAC 106—Service manual (100 pages) points out how the widely varying conditions influencing gas appliance installations can affect "Baso" automatic safety pilots, and discusses corrective steps which can be taken — Milwaukee Gas Specialty Co., P.O. Box 161, Milwaukee. It covers theory of operation, and disassembly and repair procedures, and includes a parts catalog.

### Blower Type Unit Heaters

HPAC 107—Catalog DS-327-A offers selection and application data on "Torridor" blower type unit heaters (capacities from 100,000 to 1,500,000 Btu) — The Trane Co., La Crosse, Wis. They are used for large spaces, as in factories and warehouses. They serve as both heating and ventilating units, and can be used for a number of special and process applications. Various outlet arrangements are shown.

### Cascade Type Heat Exchanger

HPAC 108—Bulletin PE-8 describes a newly designed cascade type heat exchanger which can be used to cool corrosive liquids — Corning Glass Works, Corning, N.Y. It contains a series of charts designed to aid in determining specific requirements. Because the heat exchange tubes are made of corrosion-resistant glass, coolants such as raw or sea water may be used. Dimensions and construction details are given.

### Cloth Type Dust Collectors

HPAC 109—Catalog 72-B (36 pages) describes the various sizes and models of "Dustube" cloth tube type collectors — American Wheelabrator & Equipment Corp., 619 S. Byrkit St., Mishawaka, Ind. Standard assembled and knocked down models of this equipment have a range of air flow capacities upward from 252 cfm and filter the air through various kinds of cloth — cotton, wool, and synthetics — depending upon the application.

### Convectors

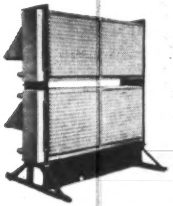
HPAC 110—Catalog gives dimensions, specifications, etc., of new "Flow Temp" series FC-210 convectors, designed for use with summer air conditioning or year round heat pump air conditioning systems — Acme Industries, Inc., Jackson, Mich. There is one basic assembly for all types of installations, the same unit being suitable for wall, wall recessed, semi-recessed, ceiling or floor mounting.

### Electric Air Heaters

HPAC 111—Folder F-1530 covers portable and built in electric air heaters used in a variety of industries and businesses — Edwin L. Wiegand Co., 7610 Thomas Blvd., Pittsburgh 8. Described are convection, blower, duct and radiant types, along with suitable automatic controls. Application photographs illustrate factory and office uses.

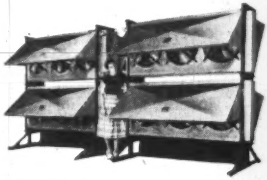
### Electrodes and Welding Alloys

HPAC 112—1952 directory of electrodes and welding alloys offers information on a series of low temperature alloys for use on cast iron, steel, alloy steels, brass, copper, and other metals — Eutectic Welding Alloys Corp., 172nd St. and Northern Blvd., Flushing 58, N.Y. Included is a



20 TON

40 TON



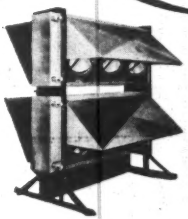
*Cut out all* **WATER** *problems*

WITH THE

# UNICON

by KRAMER

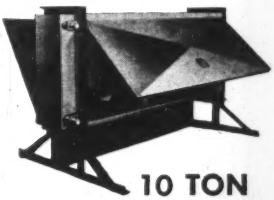
The UNICON eliminates all water problems . . . because it does not require any water. Any size compressor, regardless of tonnage, can be air-cooled with the UNICON by KRAMER. Stands, hood, and wind deflectors are available for simplified outside mounting of this Remote-Type Air-Cooled Condenser.



20 TON

SPECIAL APPLICATIONS

Write to us about your condensing problem.



10 TON

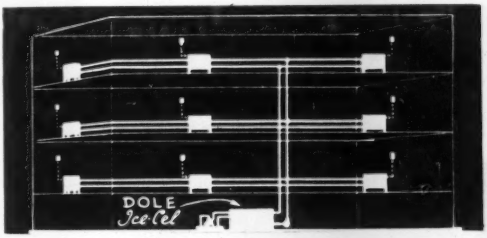
WRITE FOR BULLETIN U–177–S

KRAMER TRENTON CO.
Trenton 5, N.J.



# Don't Tear Up Floors

## to Air Condition Buildings

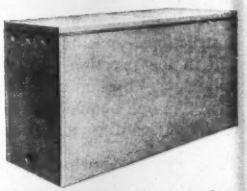



*One method of air conditioning old buildings*

USE

# DOLE

*Ice-Cels*



Show your prospects that you can air condition their buildings without tearing up floors or partitions.

**DOC DOLECO Says**

— Whether a home, a school, a church, a store, an office or a factory, DOLE Ice-Cels will provide perfect cooling comfort without tearing the building apart or interfering with the occupants.

No building owner wants the muss and litter of remodeling, the cost of expensive alterations. Show your prospects that you can install an air conditioning system by placing a DOLE Ice-Cel and compressor in the basement or unused space, running small tubing up to each floor and installing forced air convectors with separate controls for each, and you'll land the job.

It's not too early to plan for 1952. First, get complete data on Ice-Cels from your nearest DOLE representative or the factory. Then make a list of buildings in your territory needing air conditioning. By the time you have lined up orders, it will be time to get the materials and start operations.

***Write for literature and name of nearest DOLE representative.***

DOLE Vacuum COLD PLATES

**DOLE REFRIGERATING CO.**

**5918 N. Pulaski Rd., Chicago 30, Ill.**

103 Park Ave., New York 17

In Canada: Dole Refrigerating Products Limited, 44 Elgin Street, Brantford, Ontario.

chart summarizing data on uses, bonding temperatures and tensile strengths of over 100 alloys. A number of welding and cutting tools also are described.

### Expansion Joints

HPAC 113—Catalog CMH-127 describes various types of corrugated expansion joints, giving specification and installation data — Flexonics Corp. (formerly Chicago Metal Hose Corp.), 1393 South Third Ave., Maywood, Ill. It covers joints for low pressure applications, for greater amounts of traverse, and for very high pressure. Also treated are dual, hinged, balanced, and bulkhead units.

### Extended Surface Cooling Coils

HPAC 114—Revised bulletin DS-365 (72 pages) covers extended surface cooling coils for use with direct expansion refrigerants and chilled water in air conditioning or process applications — The Trane Co., La Crosse, Wis. Information has been added on a new coil for use where the quantity of water is restricted, and a redesigned coil that can be completely drained where danger of freezing exists. Included are performance data tables, selection instructions, specifications and other details designed to aid in the selection of the proper design for specific applications. Special consideration is given to coils used for gas cooling, butane vaporizing, transformer oil cooling, generator cooling, and condensing of gaseous refrigerants.

### Film Type Heating Elements

HPAC 115—Booklet outlines the uses, methods of application, mechanical, thermal, and electrical characteristics of a film type heating element (an electrically conductive plastic) designed to provide uniform heat distribution and maximum heat transfer — Electrofilm Corp., 7116 Laurel Canyon Blvd., North Hollywood, Calif.

### Glass Fiber Insulation

HPAC 116—Folder describes the general applications and performance characteristics of "Ultralite" glass fiber insulation (thermal and acoustical), and 16 page catalog covers its use as duct insulation (thermal — applied to the exterior) and duct liner (acoustical — applied to the interior) — Gustin-Bacon Mfg. Co., 1112 W. 12th St., Kansas City 7, Mo. The material consists of long, drawn glass fibers, bonded together with a thermo-setting plastic resin. The folder describes it as fire resistant, rotproof, odor and corrosion resistant, and vibrationproof. The catalog covers its thermal and acoustical efficiency, and treats selection factors and methods of application for its use as duct insulation and liner.

### Horizontal Tank Capacity Chart

HPAC 117—Chart for figuring the number of gallons of a liquid in any horizontal tank, without the use of tables, formulas or computations — Armstrong Machine Works, 874 Maple St., Three Rivers, Mich. The chart and an explanation of its use are printed on an $8\frac{1}{2}$ x 11 in. card suitable for wall hanging.

### Indicating and Recording Flue Gas Analyzer

HPAC 118—Instrumentation data sheet 10.15-3a describes an indicating and recording flue gas analyzer

# AIR-FLO

**AUTOMATIC**

## CEILING SHUTTER

**FOR ATTIC FAN**

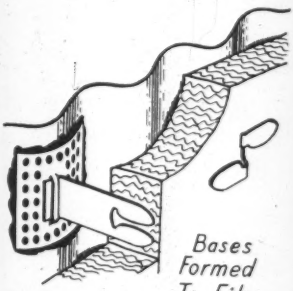
Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 73" long. No operating mechanism shown. Built-in fusible link. Meets fire underwriters requirements.

**WRITE FOR NEW CATALOG 44-C**
Illustrations and details of the complete AIR-FLO line.

**AIR CONDITIONING PRODUCTS CO.**
2340 W. LAFAYETTE BLVD. · DETROIT 16, MICH.

# Stic-Klip

**For Insulation Installation**



on
Air Ducts
Fans
Penthouses
Buildings.

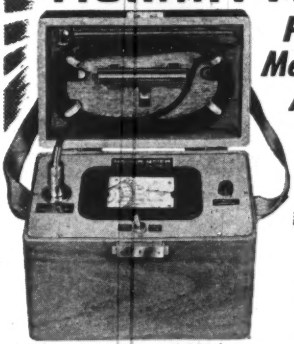
Bases Formed To Fit Standard Corrugations.

*and for applying Sound Absorbing Liners*

**Stic-Klip** MANUFACTURING CO.
50 Regent St. Cambridge 40 Mass.

# AGITAIR® METER

*For Accurate Measurement of Air Velocity and Air Pressure*



***Low Velocity Range: 0-750 fpm***
***High Velocity Range: 750-4000 fpm***
***Pressure Range: 0-4 inches water***

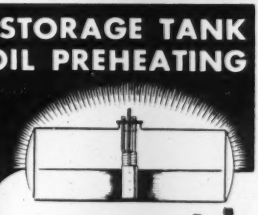
Based on the hot thermopile principle, the AGITAIR Meter gives instantaneous accurate measurements of air velocities as low as 5 fpm, and as high as 4000 fpm. It is inherently stable, does not waver or jerk and unlike many resistance type hot-wire instruments it is free from errors caused by temperature variations, radiation effects and lead resistance. For taking static pressure readings from 0 to 4" wg, a special attachment is provided. The simplicity and utility of the AGITAIR Meter make it useful for many diverse applications.

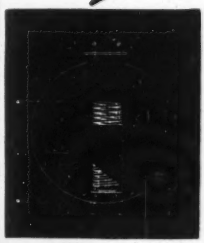
*Write for Bulletin AM-100*

**AIR DEVICES Inc.**
17 East 42nd Street New York 17, N. Y.
Air Diffusers • Air Filters • Exhausters

# Solve STORAGE TANK OIL PREHEATING

## REMPE "Hot Spot" PREHEATER





**All-steel shell and coil assembly for preheating No. 5 and Bunker "C" oils and other liquids to proper flow temperature before they enter the suction pipe. Positive pre-heating by flow accumulator.**

**Suction pipe, inlet and outlet pipes for heating by steam or hot water go through manhole cover. Made with 14" or 16" dia. shell.**

***WRITE FOR DETAILS.***

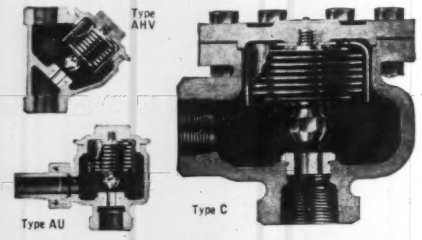
HEAT TRANSFER EQUIPMENT REMPE CO. Founded 1900

**REMPE COMPANY**
342 N. Sacramento Blvd., Chicago 12, Ill.

Nicholson Traps Help

**CUT STEAM COST $500,000 A YEAR**

At one of the nation's large processing plants a campaign to promote economical steam use by improving heat transfer efficiency has resulted in a yearly saving of $500,000. Credit for a fair portion of this is given to improved steam trapping, which resulted from the installation of Nicholson thermostatic traps. To see why an increasing number of leading plants are standardizing on Nicholsons for positive drainage and faster heat transfer, send for **BULLETIN 450.**




**W. H. NICHOLSON & CO.**

**TRAPS · VALVES · FLOATS**

**198 OREGON ST., WILKES-BARRE, PA.**

Simplify PIPING MAINTENANCE

*Use Reliable*

**JEFFERSON UNIONS**

Poor piping installations are eliminated when the joints are made with Jefferson Unions. We know you want the best that's why we make them from a very fine malleable iron having a tensile strength of 55,000 lbs per sq in . . . why we cut the brass rings from special tubing . . . why we air test them before shipping . . . why the ring channels are *machined* instead of cast. We are sure they will provide the answer to any and all piping problems.

*Drop us a line today for more information.*

**JEFFERSON UNION CO.**

607 West 26th Street, New York 1, N. Y.
35 Fletcher Avenue, Lexington 73, Mass.
65 Gooding Street, Lockport, N. Y.

utilizing a "Davis" thermal conductivity gas analyzer combined with an "Electronik" recorder — Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 40, Wayne and Windrim Aves., Philadelphia 44. It explains how the equipment is used for combustion control analysis, and illustrates operation and construction.

### Industrial Measuring and Control Instruments

HPAC 119—Catalog 5000 (28 pages) describes measuring instruments, control devices and related components — Minneapolis-Honeywell Regulator Co., Brown Instruments Div., Station 40, Wayne and Windrim Aves., Philadelphia 44. Specifications are given for approximately 100 instruments manufactured by the company's Industrial Div. Valves are outlined, and several new designs (differential controller, etc.) are included.

### Industrial Electric Unit Heaters

HPAC 120—Catalog EC-62R describes, illustrates and gives specifications for suspension type, combination portable and suspension, and explosionproof heaters with electric heating elements — Electromode Corp., 45 Crouch St., Rochester 3, N.Y. It includes data on control equipment, contains mounting and wiring diagrams, and illustrates typical installations.

### Limit Switches

HPAC 121—Bulletins cover three types of limit switches, giving descriptive data, application information, ratings, etc. — General Electric Co., Schenectady 5. Bulletin

**MEET THE NEW MODEL**

**MUCKLE VENTS**

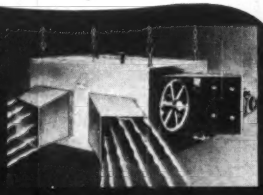
Take a look at the new silhouette . . . . it's low slung and streamlined — better looking on any roof!

Get away from old, "eye sore" ventilators — get the newly designed Muckle Vents. Engineered for better performance in moisture laden air — the motor is out of line of air flow. A compact, good looking, easy to install all-in-one unit to fit any roof.

Write today for more information on Muckle Vents.

Muckle MANUFACTURING CO.
OWATONNA 8, MINN.

HERE'S YOUR ANSWER TO LARGE AREA SPACE HEATING!



CHROMALOX
*Blower Type*
UNIT HEATERS

**FOR HEAVY-DUTY HEATING IN FACTORIES, WAREHOUSES, OFFICES**

Ceiling mounted CHROMALOX Electric Blower-Type Heaters are your quick, easy answer to space heating! Twin centrifugal fans, driven by a 3-phase motor, distribute warmth evenly over large areas. Air ducts can be used to convey heated air to desired locations. Automatic thermal cutout assures protection against overheating. 51,180 to 136,480 BTU output per hour.

HAVE A HEATING PROBLEM OF ANY KIND?

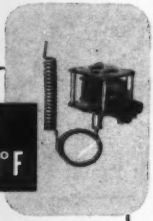
Then write for Catalog 50. It's loaded with information on many of the 15,000 types, sizes and ratings of Chromalox Heating Units and Equipment.

Industrial Div., EDWIN L. WIEGAND CO., 7610 THOMAS BLVD., PITTSBURGH 8, PA.

CHROMALOX IB-8

*ELECTRIC HEAT FOR MODERN INDUSTRY*

TYPE F43A



A DUAL SWITCH THERMOSTAT FOR USE FROM -150° F to +600° F

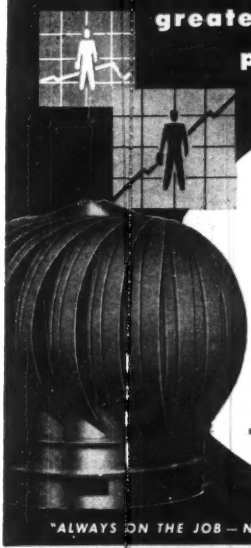
Manufacturers with thermal control problems similar to those encountered in water baths, industrial ovens, hot plate presses, coffee roasters and heating equipment should investigate the Type F43A dual switch thermostat. It is a precision-built temperature control available with a wide variety of thermal assemblies and switches for use between -150° F and +600° F. It can control two separate circuits simultaneously as required, for instance, in an air conditioning system where a fan control and compressor control are required.

Write for bulletin #3-4 which gives full specifications.

UNITED ELECTRIC CONTROLS COMPANY
87 School Street, Watertown, Mass.

STANDARD & SPECIAL THERMOSTATS & PRESSURE SWITCHES

How to promote greater PER-MAN productivity!



**Well-ventilated working environments contribute to faster, better defense production.**

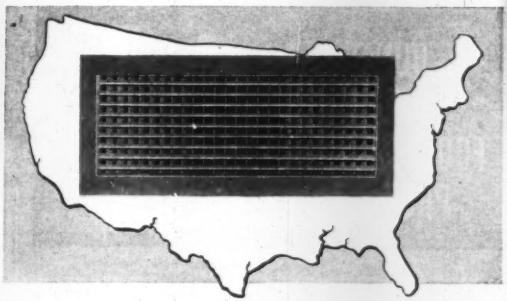
Western Rotary Turbine Ventilators provide constant, round-the-clock exhaust *without power*. A 2-mph breeze keeps your Western Rotary System in operation. Lifetime guaranteed bearings are both mounted on the same axis . . . always stay in alignment. Throat sizes 6" through 48", with the clean, low silhouette progressive industry demands.

Complete, up-to-the-minute information, sizes, capacities, and prices on all Western equipment upon request. In 1951 SWEETS and A.E.C.

**In Stock At Your Favorite Wholesalers.**

*"ALWAYS ON THE JOB — NEVER ON THE PAYROLL"*

WESTERN ENGINEERING & MFG. CO.
1726-28 E. WASHINGTON BLVD., LOS ANGELES 21, CALIF.



*From Coast to Coast!*

STEWART High Velocity Outlets are used for QUIET DIRECTIONAL air distribution.

We would like to supply your needs, too!

There are qualified representatives in principal United States cities — in Canada, Douglas Engineering Co., Ltd. Montreal — or write direct to factory.

Stewart MFG. CO., INC.
CEDAR GROVE
NEW JERSEY

100

Fig. 3640 Close-Cupld Centrifugal

## How a Thrifty Feature Can Make Your Air Conditioning Customer Happy

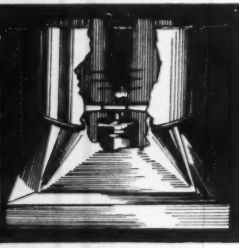
We're all interested in ways of saving money. Your air conditioning customer is no different. He'll be pleased if you can point out how little power is used by his air conditioning installation.

To keep power consumption low, use a Goulds pump in your air conditioning unit. Careful engineering, top-grade materials, and skilled workmanship are combined in Goulds pumps. They operate year after year at top efficiency—lowest power input for the job done, and long years of perfect service.

*Call or write Pump Headquarters for complete information.*

Goulds PUMPS INC.
Seneca Falls
New York

DON'T LET FOUL AIR FOUL UP YOUR PRODUCTION



Automatic Roof Ventilator
Propeller Pitch Adjustable
Balanced Damper Flaps

Eliminating foul air is our JOB. Industrial Air manufactures fans and ventilating equipment to fit your specifications and JOB needs. Available in all sizes, from 14" through 72" in diameter, belt or direct driven operation.

*Duct Fans*
*Direct or Belt Driven*
*Utility Man Cooler*
*Portable Man Cooler*
*Roof Ventilators*
*Duct Type Fan*
*Duo Duct*

AIR Represented in All Principal Cities
Write Dept. 211 for Complete Catalog

THE HARVEY P. BERTRAM CO.
1008 W. Ninth St. Cincinnati, Ohio


GEA-5704 describes the rotating type limit switch, for use where reversing operation is to be coordinated with the number of revolutions of a motor shaft or driven equipment. Bulletin GEA-5705 covers the lever type switch, for use where it is required to make or break a control circuit at a certain point in the travel of a machine part or mechanism. Bulletin GEA-5707 deals with the track type switch which is offered with four interchangeable operating heads for a wide variety of general purpose applications.

### Motors

HPAC 122—1952 catalog gives technical data on a complete line of heavy duty single phase and polyphase motors (1/20 to 5 hp) — Triad Engineering Corp., 450 E. Ohio St., Chicago 11.

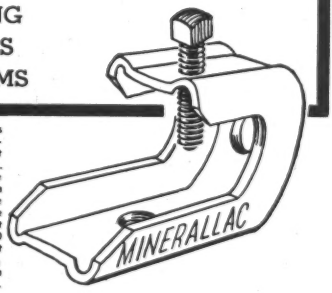
### Synclinal Type Filters

HPAC 123—Folder gives engineering data on synclinal type filters for sump or line installation on hydraulic and low pressure liquid recirculating systems — Marvel Engineering Co., 625 W. Jackson Blvd., Chicago 6.

### Wire Parts and Products

HPAC 124—Technical handbook discusses types of steel wire, steel wire sizes and comparison of gages, automatic wire forming, resistance welding, plating and finishing, and gives other technical data — E. H. Titchener & Co., 65-69 Clinton St., Binghamton, N.Y.


MINERALLAC
BEAM CLAMPS
FOR MOUNTING HANGERS ON I-BEAMS




Mounts Minerallac hangers No. 0 to No. 6 on I-Beams safely without necessity of drilling holes. Made of heavy gauge zinc plated steel with deep drawn ribs to give needed strength, these durable, light weight beam clamps have 1/4-20 trapped holes—will fit beam flanges up to 1/2 inch thick. Furnished with case-hardened set screw. Low cost.

*Order From Your Electrical Wholesaler*
SEND FOR LITERATURE
MINERALLAC ELECTRIC COMPANY
25 North Peoria St. Chicago 7, Ill.
MINERALLAC

HIGH CAPACITY
RADIATION
FOR
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
Installation

COMPACT
CONVECTORS

Steel or
Aluminum Fins

SEE Catalog in Sweet's Architectural, Industrial, Engineering, Catalog Directories

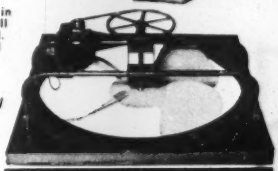
Stedco Products

Kingston, Penna.
Wilkes Barre, Penna.

Cash in!

ON THE TREND TOWARD
Murray
THE FAN THAT SELLS ITSELF

There is a trend toward home and industrial ventilation.
This past year was the largest in ventilating-fan history. 1952 will be larger. Cash in on the trend. Sell *MURRAY*, the most demanded fan in the rich Southern fan market.



EVERY Murray FAN
IS A COMPLETE
VENTILATING SYSTEM

Murray Ventilating Fans
Flat-as-a-flounder, vertical discharge (as above) or upright horizontal discharge for attics, larger residences, factories, stores and institutions.

♦ MURRAY WINDOW FANS
20" for smaller homes and apartments. 24" for larger residences and offices. Attractive off-white and chrome finish-protective grill, "Whisper-quiet". Up to 5030 CFM.

Murray
COMPANY OF TEXAS
For information, write to:

VENTILATING & WINDOW FANS
H. C. BIGLIN COMPANY, INC.
177 HARRIS STREET, N.W. ATLANTA, GEORGIA

*classified advertising . . .*

Is the quick, economical way to find what you're looking for. Check the classified page each and every issue for real bargains and hard to find items. It's a quick and sensible means too, of disposing of tools, equipment, and anything else for which you no longer have use. Check the classified page for rates.


# CLASSIFIED ADVERTISING

***Classified Section:** Rates for classified advertising are 12 cents for each word, including heading and address. One inch $6.00. Count nine words for keyed address. Minimum $2.00 for each insertion. Cash must accompany order.*

## Manufacturers' Agents

*Are you interested in securing additional lines?*

We are occasionally asked by our manufacturer advertisers to suggest the names of manufacturers' agents in various sections of the country whom they can contact in regard to representation of their industrial large building heating, piping and air conditioning products.

If you would like your name listed on our records for inquiries we may receive on your territory, we invite you to write us. There is no charge in connection with this service.

**HEATING, PIPING & AIR CONDITING**

6 N. Michigan Ave. Chicago 2, Ill.

### *for sale*

FOR SALE — Sheet metal, roofing, plumbing and heating shop and supplies department. In the chemical center of the world, doing industrial and commercial sales and work. Address Oscar Sergent, broker, Dunbar, West Virginia.

### *situations open*

Engineer-Draftsman: Wanted by large railroad, college graduate in Mechanical Engineering, to handle mechanical features required in connection with design of modern buildings and shop facilities. Experience desirable. Write Key #924-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2, Ill.

Wanted: An experimental engineer well versed in boiler constructing and building. Position now open in company manufacturing heating and power boilers. State experience, personal qualifications and salary expected in letter to Key #925-A Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2, Ill.

# INDEX TO ADVERTISERS


A-J Mfg. Co. ... *
Acme Industries, Inc. ... 60
Aerofin Corp. ... *
Air Conditioning Products Co. ... 217
Air Devices, Inc. ... 217
Air-Maze Corp. ... 196
Airtherm Mfg. Co. ... 192
Alco Valve Co. ... 58
Aldrich Co. ... *
Allen-Bradley Co. ... *
Allis-Chalmers Mfg. Co. ... 9 & 153
American Air Filter Co. ... 59
American Blower Corp. ... 35
American Brass Corp., The ... 39
American Chain & Cable Co., The ... 164
American Radiator & Standard Sanitary Corp. ... 13
American Wheelabrator & Equip. Corp. ... *
Ames Iron Works ... 202
Anderson Co., V. D. ... *
Anemostat Corp. of America ... *
Armstrong Cork Co. ... 62
Armstrong Machine Works ... *
Atlas Mfg. Co. ... *
Auer Register Co. ... 204
Aurora Pump Co. ... 205
Autorad, Inc. ... *

Babcock & Wilcox Co. ... *
Bacharach Industrial Instrument Co. ... *
Badger Manufacturing Co. ... 201
Baker Refrigeration Corp. ... *
Barber-Colman Co. ... 31 & Facing 174
Barnes & Jones, Inc. ... *
Bayley Blower Co. ... *
Bell & Gossett Co. ... 11 & 159
Bertram Co., The, Harvey P. ... 220
Binks Mfg. Co. ... *
Bishop & Babcock Mfg. Co., The ... *
Bituminous Coal Institute ... 41
Black & Decker Mfg. Co. ... 199
Breidert Co., G. C. ... *
Brunner Mfg. Co. ... 157
Buffalo Forge Co. ... 26 & 27
Buffalo Pumps, Inc. ... 34
Bundy Tubing Co. ... 29
Bush Mfg. Co. ... *
Byers Co., A. M. ... 4

Campbell Heating Co. ... *
Carey Co., Phillip, The ... *
Carrier Corp. ... 8 & 184
Cash Co., A. W. ... *
Century Electric Co. ... 24
Chase Brass & Copper Co. ... 185
Chicago Blower Corp. ... *
Chicago Pump Co. ... *
Clarage Fan Co. ... Inside Back Cover
Cleaver-Brooks Co. ... *
C-O-Two Fire Equipment Co. ... *
Combustion Engineering—Superheater Inc. ... 152
Committee on Steel Pipe Research of American Iron & Steel Institute ... 170
Condenser Service & Engineering Co. ... *
Connor Engrg. Co., W. B. ... 193
Continental Air Filters, Inc. ... *
Correctair Div., Boyle-Midway, Inc. ... 177
Crane Co. ... 6
Crocker-Wheeler Div., Elliott Co. ... 37
Curtis Refrigerating Machine Co. ... *
Cyclotherm Corp. ... *

De Bothezat Fans Division American Machine & Metals, Inc. ... 181
Delaun Mfg. Co. ... *
Delco Prods. Div., General Motors Corp. ... 173
Detroit Lubricator Company ... *
Diamond Power Specialty Corp. ... *
Dodge Mfg. Co. ... 22
Dole Refrigerating Co. ... 215
Dole Valve Co., The ... *
Dollinger Corp. ... 15
Dravo Corporation ... 33
Dunham Co., C. A. ... *
Dwyer Mfg. Co., F. W. ... *

Eagan Co., Inc., Walter H. ... *
Economy Pumps, Inc. ... *
Electromode Corp. ... 203
Elliott Company ... 37
Emerson Elec. Mfg. Co. ... 187

Fairbanks Co. ... *
Farr Co. ... 7
Fedders-Quigan Corp. ... 42 & 43
Field Control Div., H. D. Conkey & Co. ... 30
Fisher Governor Co. ... *
Fitzgibbons Boiler Co., Inc. ... *
Fluid Systems ... *
Foster Wheeler Corp. ... *
Frick Co. ... *
Fulton Sylphon Co. ... *

G. & O. Mfg. Co., The ... *
Gallaher Co. ... *
General Controls Co. ... *
General Electric Co. ... 165
General Fittings Co. ... *
Glasfloss Corp., The ... *
Goulds Pumps, Inc. ... 220
Governair Corp. ... 198
Greenlee Tool Co. ... *
Grinnell Co., Inc. ... Inside Front Cover

Hajoca Corporation ... *
Hamilton-Thomas Corp. ... *
Handy & Harman ... 197
Hapman-Dutton Co. ... *
Hastings Instrument Co., Inc. ... *
Hayes Furnace & Mfg. Co., Inc. ... *
Hays Corp. ... *
Hendrick Mfg. Co. ... *
Henry Valve Co. ... *
Hoffman Specialty Co. ... *
Holsclaw Bros., Inc. ... *
Howell Electric Motors Co. ... 32
Hussey & Co., C. G. ... 51

Ilg Electric Ventilating Co. ... *
Illinois Engineering Co. ... *
Illinois Testing Laboratories, Inc. ... 214
Independent Register Co. ... *
Industrial Accoustics ... *
Industrial Sound Control Inc. ... 206
Infra Insulation, Inc. ... 183
Ingersoll-Rand ... *
Iron Fireman Mfg. Co. ... *

Jackson & Church Co. ... *
Jefferson Union Co., Inc. ... 218
Jenkins Bros. ... 178
Jenn Air Products Co. ... *
Johns-Manville ... 195 & Facing 175
Johnson Co., S. T. ... *
Johnson Corp. ... *
Johnson Service Co. ... *
Joy Mfg. Co. ... *

Kaylo Div., Owens-Illinois Glass Co. ... *
Keasbey & Mattison Co. ... *
Kennard Corp. ... 18
Kennedy Valve Mfg. Co., The ... *
Kewanee Boiler Corp. ... 158
Key Co. ... *
Klipfel Valves, Inc. ... *
Korfund Co., Inc., The ... 203
Kramer Trenton Co. ... 215
Kritzer Radiant Coils, Inc. ... *

Ladish Co. ... *
Lee Corporation, The ... *
Leslie Co. ... *
Lincoln Electric Co., The ... *
Lunkenheimer Co., The ... 149
Lycoming Spencer Div., Avco Mfg. Corp. ... *

Maid-O'-Mist, Inc. ... *
Marley Co., The ... 57
Marlo Coil Co. ... *
Marsh Heating Equipment Co. ... 176
McCord Corp. ... *
McDonnell & Miller, Inc. Outside Back Cover
McQuay, Inc. ... 167
Mercoid Corp., The ... *
Mettler Co., Inc., The ... *
Mid-Continent Metal Products Co. ... *
Midwest Piping & Supply Co. ... 47
Minerallac Electric Co. ... 220
Minneapolis-Honeywell Regulator Co. 44 & 45
Modine Mfg. Co. ... 48
Muckle Mfg. Co. ... 218
Mueller Brass Co. ... 40
Mueller Furnace Co., L. J. ... *
Multi-Vent Div., Pyle National Co. ... 38
Mund Boilers, Inc. ... 207
Mundet Cork Co. ... *
Murray Co. of Texas, The ... 221
Mystik Adhesive Products ... *

Nash Engineering Co. ... 70
National Heater Co. ... *
National Radiator Co., The ... *
National Tube Co. ... *
Nelson, Herman Div. of American Air Filter Co., Inc. ... 188 & 189
Nesbitt, Inc., J. J. ... 66
New York Blower Co., The ... *
Niagara Blower Co. ... 207
Nicholson & Co., W. H. ... 218

Ohio Brass Co. ... 56
Ohio Injector Co. ... *
Olson & Company, Arthur A. ... 199
Orr & Sembower, Inc. ... 171
OverHead Heaters, Inc. ... *
Owens-Corning Fiberglas Corp. ... 50

Patterson-Kelley Co., Inc., The ... *
Peerless Elec. Co. ... *
Peerless Pump Div., Food Machinery & Chemical Corp. ... 25
Penn Electric Switch Co. ... *
Penn Ventilator Co. ... 213
Perfex Corp. ... *
Pittsburgh-Corning Corp. ... 155
Porter & Co., H. W. ... *
Powers Regulator Co., The ... 53 & 54
Prat-Daniel Corp. ... 208
Preferred Utilities Mfg. Co. ... *
Pritchard Co., J. F. ... 46
Propellair, Inc. ... 209

Quijada Tool Co., Inc. ... 200

R P & C Division American Chain & Cable Co., The ... 164
Ramset Fasteners, Inc. ... *
Ray Oil Burner Co. ... *
Reading Tube Corp. ... 154
Refinite Corp. ... 216
Register & Grille Mfg. Co. ... *
Reinhard Brothers Co. ... *
Rempe Co. ... 217
Republic Steel Corp. ... 52
Research Products Corp. ... *
Revere Copper & Brass, Inc. ... 69
Reznor Manufacturing Co. ... *
Ric-wil Co., The ... 209
Ridge Tool Co. ... 186
Rockwell Co., W. S. ... *
Roth Co., Roy E. ... *
Rubber & Plastics Compound Co. ... 211

SKF Industries, Inc. ... *
Sarco Co., Inc. ... 55
Sarcotherm Controls, Inc. ... *
Schaub Engineering Co., Fred H. ... 166
Sellers Engineering Co. ... *
Servel, Inc. ... *
Siemon & Co. ... 210
Skidmore Pumps ... *
Skilsaw, Inc. ... 163
Smith Co., Inc., H. B., The ... *
Spaeth-Chalfant Div. of The National Supply Co. ... 61
Spence Engineering Co., Inc. ... 28
Spencer Heater ... *
Sporlan Valve Co. ... *
Spraying Systems Co. ... *
Standard Stamping & Perforating Co. ... 213
Stedco Products ... 221
Stephens-Adamson Mfg. Co. ... *
Sterling, Inc. ... *
Sterling Electric Motors ... *
Stewart Mfg. Co. ... 219
Stic-Klip Mfg. Co. ... 217
Superior Combustion Industries, Inc. ... *
Surface Combustion Corp. ... *
Swartwout Co. ... *

Taco Heaters, Inc. ... 150
Taylor Forge & Pipe Works ... 21
Taylor Instrument Cos. ... 168
Thrush & Co., H. A. ... 19
Titus Mfg. Corp. ... 169
Titusville Iron Works Co., The, Div. of Struthers Wells Corp. ... *
Trane Co., The ... 20
Tri-Clover Machine Co. ... *
Tube Turns, Inc. ... *
Tuttle & Bailey, Inc. ... *
Typhoon Air Conditioning Co. ... 212

Union Asbestos & Rubber Co. ... 190 & 191
Unistrut Products Corp. ... *
United Cooling Tower Co. ... *
United Electric Controls Co. ... 219
United States Air Conditioning Co. ... 3
United States Steel Co. ... 17
United States Steel Supply Co. ... 156
Utility Appliance Corp. ... *

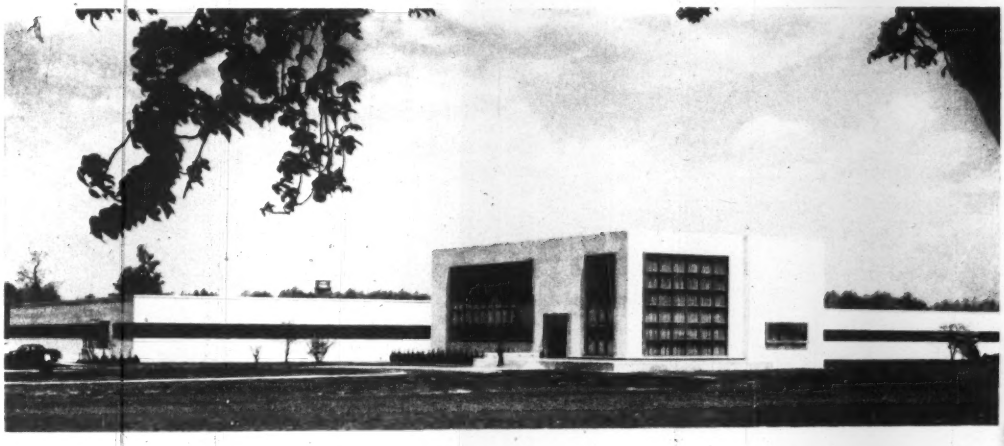
Vilter Manufacturing Co., The ... 211
Vulcan Radiator Co. ... *

Wagner Electric Corp. ... 16
Walton Laboratories ... *
Walworth Co. ... 10
Ward Leonard Elec. Co. ... 194
Watson-Stillman Co. ... *
Webster & Co., Warren ... 65
Webster Engineering Co., The ... 201
Weil Pump Co. ... *
Welding Fittings Corp. ... 151
Western Engineering & Mfg. Co. ... 219
Westinghouse Electric Corp., Sturtevant Division ... 12
Wheatland Tube Co. ... *
Wheeler Mfg. Co., C. H. ... *
White-Rodgers Electric Co. ... *
Whitlock Mfg. Co. ... *
Wiegand Co., Edwin L. ... 219
Will-Burt Company, The ... 174
Williams Valve Co., D. T., Div. of The Schaible Co. ... 49
Wilson & Co. ... *
Wilson, Inc., Grant ... *
Wing Mfg. Co., L. J. ... 161 & 205
Wolverine Tube Div. of Calumet & Hecla Consolidated Copper Co. ... 160
Worthington Pump & Machinery Corp. ... 14

Yarnall-Waring Co. ... 23
Yates-American Machine Co. ... *
York Corporation ... 162
York-Shipley ... *
Young Radiator Co. ... *
Youngstown Sheet & Tube Co. ... 36

Zallea Bros. ... 175


Firms represented in this issue are identified by the folio of the page on which their advertising appears. Advertising which appears in other issues is marked with an asterisk.



# CLARAGE SELECTED
## FOR JOHNSON & JOHNSON RESEARCH

**ARCHITECT**
Alexander P. Morgan
New York City

**MECHANICAL ENGINEER**
Guy B. Panero
New York City

**GENERAL CONTRACTOR**
John W. Ryan Construction Co.
New York City

**AIR CONDITIONING CONTR.**
Blocker Corporation
Newark, New Jersey

**See CATALOG S-52**
Clarage Multitherm conditioning units and fans are covered in Sweet's 1952 Architectural File and in the January 1952 Directory issue of Heating, Piping and Air Conditioning—or write us.

**Industry has a high regard for Clarage air handling and conditioning equipment** . . . makers of phamaceuticals and allied products a typical example.

Our service to this field dates back nearly 40 years. Today the most honored names in the industry — **American Cyanamid, Johnson & Johnson, Lilly, Monsanto, Parke Davis, Upjohn** — rely on Clarage for help in various phases of research, production, and/or power generation.

This great new Research Center of Johnson & Johnson — North Brunswick Township, N. J. — is a recent Clarage installation.

Here Clarage meets both air handling and conditioning requirements, and they are of exacting nature. Installed equipment includes 7 Clarage Multitherm conditioning units and 23 Clarage fans.

What do engineers, contractors, users like about Clarage? The answer is simple: Clarage equipment meets your requirements with **economical performance** for a long time to come.

YOU CAN RELY ON

# CLARAGE

HEADQUARTERS FOR AIR HANDLING & CONDITIONING EQUIPMENT

**Clarage Fan Company** 627 PORTER STREET *KALAMAZOO, MICH.*

*SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES*

**IN CANADA:** Canada Fans, Ltd., 4285 Richelieu St., Montreal

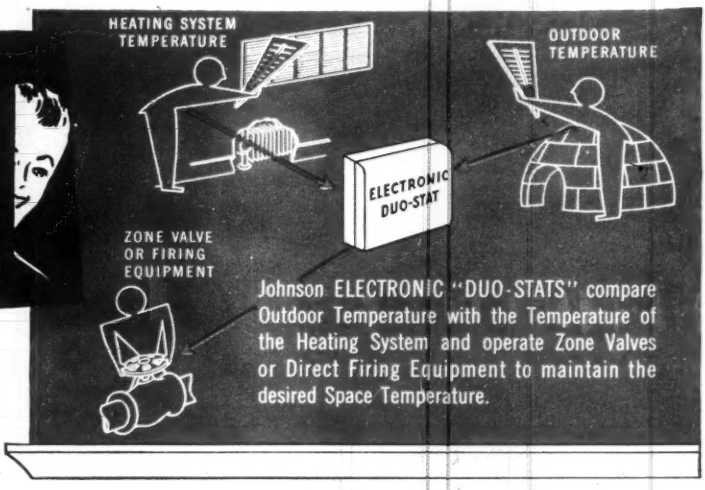
*the chances are*

YOU CAN REDUCE HEATING COSTS WITH

# JOHNSON

ELECTRONIC

# *DUO-STATS*




Johnson ELECTRONIC "DUO-STATS" compare Outdoor Temperature with the Temperature of the Heating System and operate Zone Valves or Direct Firing Equipment to maintain the desired Space Temperature.

2 NEW AND IMPROVED MODELS

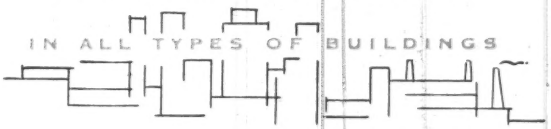
T-385 Standard Model Electronic Duo-Stat. Complete with indicating lights and 3-position manual switch, "Off-Auto-Control-On."

T-386 Clock Model Electronic Duo-Stat. Available with either 24-hour or 7-day program clock. Complete with indicating lights and 5-position manual switch, "Off-Nite-Clock-Day-On."

## CHANGE THE SIZE OF THE HEATING SYSTEM

## . . . TO FIT THE WEATHER

IN ALL TYPES OF BUILDINGS



The Johnson Electronic *Duo-Stat*, pioneer in the field of electronic controllers, employs an accurate dependable resistance circuit, together with a sensitive, yet rugged, amplifying mechanism. Johnson Electronic *Duo-Stats* have been in successful operation in all types of buildings, and applied to all types of heating systems, over a period of twelve years. Fuel savings which have resulted, coupled with the unique operational features afforded by Electronic *Duo-Stats*, prompted the design of these two, new and improved models.

These precision "weather-compensated" heat controllers are designed for universal application to heating systems of every type, in all kinds of buildings. In every case, the *Duo-Stat* supplies exactly the right amount of heat to compensate for changes in outdoor conditions.

Ask a Johnson engineer from a nearby branch office for recommendations on any temperature control problem—large or small—in both new and existing buildings. There is no obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

# JOHNSON *Automatic Temperature and Air Conditioning* CONTROL

MANUFACTURE • APPLICATION • INSTALLATION • SINCE 1885